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THE SOIL OF TAGAYTAY RIDGE, CAVITE

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ONE PLATE AND ONE TEXT FIGURE

Tagaytay Ridge in Cavite Province, Luzon, has been considered as a future health resort and possibly a second summer capital of the Philippines. Since, moreover, this region is located near Manila it would be a good place for raising vegetables and fruits for the Manila market, provided the local conditions justify such an agricultural development on a large scale.

The object of this investigation was to obtain information concerning the climatic and geologic conditions of Tagaytay Ridge and particularly to study the morphological, physical, and chemical characteristics of the soil.

Before the opening of the Tagaytay road to Batangas, a large portion of Tagaytay Ridge was a veritable cogon, *Imperata cylindrica* (Linn.), and talahib, *Saccharum spontaneum* Linn., area. Since the opening of this road there has been considerable agricultural development in this region, and at present a large portion of Tagaytay Ridge is under casual cultivation with various crops.

Formerly abacá, *Musa textilis* Née, was the lucrative crop, but the bunchy-top disease wiped out this plant completely. The areas thus vacated have been used for other purposes. Upland rice, planted once a year during April and May, is the most important staple crop.

Corn, next to rice in importance and acreage, is planted in rotation with rice. It is either allowed to mature or sold green at Mendez and other important points along the road. The

mature corn is sold, shelled or unshelled, for much less than the prices received for the green corn.

The yield of corn and other crops has never been ascertained accurately, because neither the tenants nor the landlords pay much attention to the area planted and the amount harvested. They merely estimate roughly whether the yield is good or poor.

Truck gardening is considered quite profitable. The tomato grows very well, and it has been reported that an eighth of a hectare will yield a crop of tomatoes valued at about 50 pesos.

Bananas are planted here and there along the sides and in the corners of the fields. Chayote, *Sechium edule* S. W., a newly introduced tropical vegetable of climbing habit, is also gaining in popularity among the farmers. The sandy loam soil and the cool climate of Tagaytay are very suitable for the cultivation of this plant, which is now grown in Baguio and sold in Manila.

Other crops that are popular in this region are peanuts, camotes, mustard, and pechay.

DESCRIPTION OF THE AREA

The location of Tagaytay Ridge is shown in the map (text fig. 1), which was taken from Father Selga's report.(1) The ridge (Plate 1) is the summit of a flat-topped area lying between Batangas and Cavite Provinces. From the bay shore of Manila the ridge appears to be an elevated table-land extending from Mount Sungay (753 meters) southwest to Balibaguhan, which is a short distance northeast of Mount Batulao (812 meters). With an elevation of about 600 meters, maintained with a very slight undulation throughout its entire length of approximately 20 kilometers, the ridge overlooks Taal Volcano, Verde Island Passage, and a portion of Mindoro on the south side, and Manila Bay and its environs on the north side. The highest portion has a width of 2 to 3 kilometers. From this location there is a gradual descent northwestward to Manila Bay.

L. A. Faustino, assistant director of the Bureau of Science, described Tagaytay Ridge geologically as representing a portion of the crater rim of an old, mighty volcano, the predecessor of the present Taal.(1) It consists of a series of consolidated volcanic tuff deposits, the products of a long series of volcanic explosions.

The Manila-Cavite-Batangas road via Indang passes through the ridge. The Manila-Silang road, when continued to Tagay-

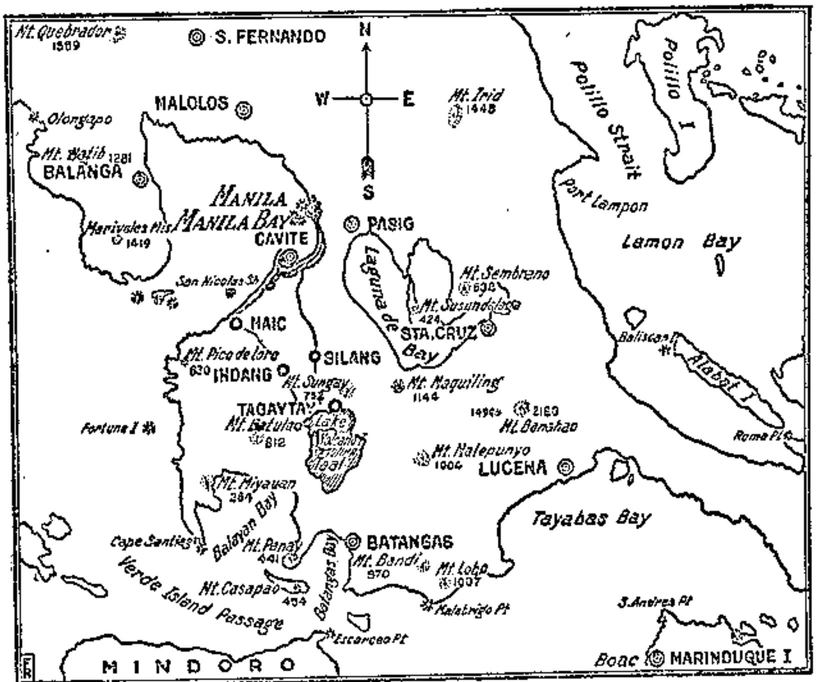

Fig. 1. Map of Cavite Province, showing Tagaytay and neighboring regions.

tay, will meet the Manila-Cavite-Batangas road and form a junction at about the middle of the ridge. A first-class road connects this junction with Manila via Indang. The distance is 78 kilometers. The towns of Mendez and Indang are now the primary markets for the farm produce of this region. Transportation of the products is facilitated by both the Batangas and the Cavite Transportation Companies.

At present the small number of people living at Tagaytay Ridge are mostly tenants employed by land owners. These tenants live in small temporary huts ("kubo"). The land owners who superintend the cultivation of the land live in the towns of Mendez, Alfonso, Amadeo, and Silang.

As there are no springs on Tagaytay Ridge, the people of Mendez pipe their drinking water from Kay-bubutong Spring. This is situated approximately 1,200 meters south of and 250 meters below the top of Tagaytay Ridge. The spring constitutes the headwaters of Bubutong River, which flows into Taal through the barrio of Birinayan near Talisay, Batangas. According to the Director of Public Works the spring has a flow of approximately 800 gallons per minute, or 1,152,000 gallons per day.(1) This is sufficient for 57,600 people based on a consumption of 20 gallons a day for each person.

CLIMATE

The Weather Bureau has made meteorologic observations for two years to get information concerning the weather and climate at Tagaytay. Generally it is dry in winter and spring and wet in summer and autumn.

TABLE 1.—*Average temperature and rainfall of Tagaytay Ridge, Manila, and Baguio.*[a]

Temperature.	Station.	Period of observation.	Monthly records.					
			January.	February.	March.	April.	May.	June.
		Years.	°*C.*	°*C.*	°*C.*	°*C.*	°*C.*	°*C.*
Mean	Manila	1885–1929	24.7	25.3	26.6	28.1	28.4	27.8
Do	Tagaytay	1928–1930	20.2	21.2	24.4	23.6	24.0	23.6
Do	Baguio	1901–1928	16.8	16.9	18.1	19.0	19.0	18.8
Maximum	Manila	1885–1929	30.1	31.0	32.6	34.1	33.7	32.4
Do	Tagaytay	1928–1930	24.0	25.8	27.3	28.6	28.4	27.6
Do	Baguio	1909–1918	22.5	22.8	24.2	24.9	24.2	23.9
Minimum	Manila	1885–1929	20.4	20.4	21.3	22.8	24.0	24.0
Do	Tagaytay	1928–1930	16.4	16.7	17.6	18.4	19.4	19.6
Do	Baguio	1909–1918	13.0	13.1	14.2	15.3	16.0	16.1
Rainfall..mm.	Manila	1865–1929	24.3	11.3	18.2	31.6	116.6	253.6
Do	Tagaytay	1928–1930	29.2	1.2	35.4	42.9	193.2	125.2
Do	Baguio	1902–1929	23.3	20.1	45.0	115.3	387.0	469.6
Rainy days	Manila	1866–1929	5	3	3	4	10	17
Do	Tagaytay	1928–1930	12	2	5	6	18	26
Do	Baguio	1902–1929	4	4	6	10	21	24

Temperature.	Station.	Period of observation.	Monthly records.					
			July.	August.	September.	October.	November.	December.
		Years.	°*C.*	°*C.*	°*C.*	°*C.*	°*C.*	°*C.*
Mean	Manila	1885–1929	26.9	26.9	26.8	26.5	25.8	25.0
Do	Tagaytay	1928–1930	22.6	22.8	22.2	22.0	21.6	20.5
Do	Baguio	1901–1928	18.2	17.9	18.1	18.2	18.0	17.5
Maximum	Manila	1885–1929	31.0	30.7	30.8	31.1	30.5	30.0
Do	Tagaytay	1928–1930	25.6	25.9	25.2	25.2	25.0	24.2
Do	Baguio	1909–1918	21.9	21.5	21.9	22.9	23.5	23.2
Minimum	Manila	1885–1929	23.7	23.8	23.7	23.1	22.2	21.2
Do	Tagaytay	1928–1930	19.5	19.8	19.2	18.8	18.2	16.8
Do	Baguio	1909–1918	15.8	15.6	15.6	15.3	14.8	14.1
Rainfall..mm.	Manila	1865–1929	421.4	414.2	357.1	189.7	137.6	60.5
Do	Tagaytay	1928–1930	521.1	286.4	496.2	271.0	170.2	69.4
Do	Baguio	1902–1929	1,023.2	1,202.2	729.9	367.6	89.0	42.5
Rainy days	Manila	1866–1929	22	22	21	17	13	9
Do	Tagaytay	1928–1930	28	22	28	20	24	20
Do	Baguio	1902–1929	28	27	25	18	9	6

[a] Selga, M., Bur. Sci. Pop. Bull. 6 (1930).

Data on the temperature and rainfall of Tagaytay compared with those of Manila and Baguio are given in Table 1, which was also taken from Father Selga's report.(1) The average temperature of Tagaytay varies between 20.2° and 24° C. and is almost the same as the mean minimum of Manila.

The average annual rainfall of Tagaytay is about one-fifth greater than that of Manila and almost one-half that of Baguio. The actual figures are: Tagaytay, 2,241.4 mm; Manila, 2,036.1 mm; and Baguio, 4,314.5 mm. During the northeast monsoon Tagaytay has more rainy days than either Manila or Baguio. The sky is rarely clear. In the daytime Tagaytay has more humidity than Manila, but there is usually a moderately cool breeze that is conducive to health and comfort.

EXPERIMENTAL PROCEDURE

In our investigation of the soil of Tagaytay we first made a detailed inspection of the region. Borings were made to determine the character of the soil at different strata. Sites were selected for taking representative soil samples. The samples were then analyzed chemically and their physical properties examined. Tests used especially in soil investigations were carried out as follows:

pH value indicating the degree of acidity or alkalinity of the soil.—This was determined by Dr. M. M. Alicante, of the Bureau of Science, who used an electrical method, employing the antimony electrode. The results are expressed according to a scale in which pH 7.0 corresponds to neutrality. Values numerically less than pH 7.0 indicate acid soils and those greater than pH 7.0 alkaline soils as shown by the following data:

pH value.	Soil reaction.
7.5 to 7.0	Alkaline.
7.0 to 6.5	Slightly acidic.
6.5 to 6.0	Acidic.
6.0 to 5.5	Markedly acidic.
5.5 to 5.0	Highly acidic.

Index of texture (degree of clayiness).—This figure is derived from two physical soil constants;(2) namely: (*a*) Moisture of the soil at the point of stickiness (M. P. S.); the results are expressed as the percentage of moisture for oven-dried soils. (*b*) The proportion of coarse to fine sand; the percentages are determined by the pipette method.

In general the index of texture equals the moisture content at the point of stickiness less one-fifth of the percentage of sand.

$$\text{I. T.} = \text{M. P. S.} - \frac{\text{Per cent sand}}{5}$$

A description of soils according to the texture index is as follows:

Texture index.	Kind of soil.
60 to 55	Heavy clay.
55 to 50	Clay loam.
50 to 40	Loam or silt loam.
40 to 25	Sandy loam.
25 to 10	Sand.

Percolation rate of water.—For this determination we used the method described by Bouyoucos.(3) This method consists in keeping the soil immersed in an excess of water, applying suction (maintained at constant pressure), and measuring the rate at which the water passes through the soil.

The apparatus consisted of a Buchner funnel connected to a graduated cylinder by means of a two-holed rubber stopper. The Buchner funnel was about 5 centimeters in diameter and 4 centimeters in depth. The cylinder had a capacity of 500 cubic centimeters.

The soil (100 grams) was soaked with water and poured into the Buchner funnel on top of filter paper, previously placed in the bottom of the funnel. The suction was then applied, and during the filtration care was taken to have the soil continually immersed in water. This was done by pouring water over a spoon and on to the soil so that the force of the water would not disturb the settled condition of the soil. The percolate was measured after about 100 cubic centimeters, or more, of water had passed through the funnel.

Water-holding capacity.—An approximate and simplified method, based on the principle of the Keen-Raczkowski box experiment,(4) was used for this determination. Instead of a box, a perforated brass cup 5 centimeters in diameter was employed. A coarse filter paper was placed in the bottom of the cup, after which the cup was soaked in water, drained, and weighed. It was next filled with soil and weighed again. The cup with soil was then soaked in water for two hours and drained for two hours; it was weighed three times at intervals

of thirty minutes. The increase in weight represented the amount of water held by the soil.

TABLE 2.—*Mechanical analysis of Tagaytay sandy loam soil.*

Horizon of soil.	Depth from surface.	Coarse sand; 2 to 0.22 mm.	Medium sand; 0.22 to 0.14 mm.	Fine sand; 0.14 to 0.07 mm.	Very fine sand; 0.07 to 0.05 mm.	Silt; 0.05 to 0.005 mm.	Clay; 0.005 mm.	Solution loss.[a]
	cm.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Surface soil "A"	24	16.5	9.2	11.6	12.2	24.2	25.9	0.4
Subsoil (Zone "B")	24–60	4.8	4.4	5.1	10.6	28.3	46.4	0.4
Subsoil (Zone "B¹")	60–100	5.0	4.6	3.8	11.7	21.7	52.4	0.8
Substratum "C"	100–130	5.0	9.5	7.2	13.2	16.4	46.8	1.9

[a] The solution loss is obtained by treating the sample with hydrogen peroxide and washing.

RESULTS

Mechanical analysis.—The mechanical analysis of the Tagaytay soil was made in accordance with the method of Olmstead, Alexander, and Middleton.(5) The results are given in Table 2. The surface soil(6) (A), the horizon of volcanic origin, is a coarse, granular, and friable sandy loam. The eruption of Taal Volcano in past years brought considerable loose volcanic material to this ridge. Deposits of such material have made a sandy loam soil that is very dark brown or nearly black in color. This character of soil ranges in depth from 50 centimeters for the deepest deposits along the top of the ridge to 12 centimeters for the shallow ones that lie on the northwestern side of the ridge about 1 to 2 kilometers below the top. This soil is granular in structure and friable in consistency. It is easily pulverized or reduced to crumb structure.

The subsoil (zones B and B[1]) is loam to clay loam in texture, very dark brown to nearly black in color, and granular to pulverulent in structure. Like the surface soil it is friable in consistency, and easily worked, crumbled, or pulverized.

The lower horizon (substratum C) is the parent material of the subsoil immediately above it. It is reddish brown in color, heavy clay in texture, and gradually becomes adobe clay as it extends downward. The adobe structure is strongly dominant in the lower section of the C horizon, thus the name adobe clay.(7)

Color of the soil.—The most important characteristic of Tagaytay sandy loam soil is the very dark to nearly black color of the surface soil. In general the color of a soil is dependent upon the content of organic matter and ferric oxide, the latter being more or less hydrated.(8) The presence of organic matter tends to blacken the soil and ferric oxide reddens it. The dark coloration of the surface soil (A) and the fairly high loss on ignition (Table 5) indicate that the soil has sufficient organic matter.

Soil profile.—The morphological and physical characteristics of the soil profile of Tagaytay sandy loam are given in Table 3.

TABLE 3.—*The morphological and physical characteristics of the soil profile of Tagaytay sandy loam.*

Depth of zone.	Morphological characteristics.	Physical properties.		
		Index of texture.	Water-holding capacity.	Percolation rate.
cm.			*Per cent.*	*cc per hour.*
4	Plant residues and mineral materials			
	Very dark brown to nearly black sandy loam; granular and mealy in structure; friable and loose in consistency.	37.00	50.16	1,196.4
24	Very dark to nearly black loam grading into clay loam; granular in structure and friable in consistency.	61.89	53.94	382.1
60	Reddish brown clay loam grading into clay; coarse granular in structure and loose in consistency. Reddish brown concretions present.	71.74	64.05	348.2
100	Parent materials. Yellowish brown to reddish brown adobe clay; soft adobe stones extending to indefinite depth.	74.87	68.83	196.7

The locality of this profile was situated about the middle of Tagaytay Ridge and is representative of this region. The index of texture, water-holding capacity, and percolation rate are given for each particular zone in this profile. As shown by the data (Table 3) the index of texture and water-holding capacity increase with the depth of the horizon, while the percolation rate decreases.

As a check on these data four representative soil samples, taken from other locations, were tested for their physical properties. The results (Table 4) were about the same as those recorded in Table 3.

TABLE 4.—*Physical properties of four representative samples of surface soils, subsoils, and substrata of the Tagaytay sandy loam soil.*

Horizon of soil.	Depth from surface.	Physical properties.		
		Index of texture.	Water-holding capacity.	Percolation rate.
	cm.		*Per cent.*	*cc per hr.*
Surface soil [a]	15– 50	39.43	50.10	1,719.2
Subsoil [b]	50– 70	64.89	59.61	510.0
Substratum [c]	60–130	69.03	59.03	216.3

[a] The surface soil is a very dark brown to nearly black sandy loam.
[b] The subsoil is a dark brown clay loam.
[c] The substratum is a reddish brown adobe clay soil.

The rolling topography of the ridge and the low percolation rate of the subsoil are conducive to erosion processes.(9) However, the coarseness of the surface soil and its rapid percolation rate (Tables 3 and 4) tend to minimize the erosive activity.(10) The Tagaytay sandy loam soil will be subject to detrimental erosion processes, which will ruin the fertility if proper husbandry of the soil is not utilized.(11)

Chemical analysis.—The soil samples were analyzed in accordance with the methods of the Association of Official Agricultural Chemists. The elements determined were nitrogen, potassium, phosphorus, calcium, and magnesium. The results of the analyses are given in Table 5. The reaction of the surface soil is slightly acidic and the acidity increases with the depth of the soil. The nitrogen content, phosphorus, lime, loss on ignition, and organic carbon decrease with depth of soil.

Dr. M. M. Alicante, of the Bureau of Science, has analyzed soils of the Don Pedro districts, such as Balayan, Nasugbu, Palico, Liang, and Tuy, which are near Tagaytay Ridge. Comparing these results with the analyses of Tagaytay Ridge soil (Table 6) the following conclusions may be drawn:

The average nitrogen and magnesium contents of the Tagaytay Ridge soil are higher than those of the Don Pedro districts, but the phosphoric anhydride, potash, and lime contents are somewhat lower.

In plant-food constituents, particularly nitrogen, the Tagaytay sandy loam soil has a sufficient amount to insure good crops under favorable weather conditions. Vegetables and fruits of good quality could easily be cultivated in this region and they would have a ready sale in Manila markets.

TABLE 5.—*Average chemical analyses of four representative samples of surface soils, subsoils, and substrata of the Tagaytay sandy loam soil.*

Horizon of soil.	Depth from surface.	pH value.	Nitrogen (N).	Phosphoric anhydride (P_2O_5).	Potash (K_2O).
	cm.		*Per cent.*	*Per cent.*	*Per cent.*
Surface soil [a]	15– 50	6.06	0.169	0.236	0.373
Subsoil [b]	50– 70	5.99	0.148	0.225	0.206
Substratum [c]	60–130	5.73	0.070	0.142	0.246

Horizon of soil.	Depth from surface.	Lime (CaO).	Magnesia (MgO).	Loss on ignition.	Organic carbon.
	cm.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Surface soil [a]	15– 50	3.20	1.39	15.77	4.58
Subsoil [b]	50– 70	1.77	1.11	12.03	3.42
Substratum [c]	60–130	1.17	1.35	11.46	2.92

[a] The surface soil is a very dark brown to nearly black sandy loam.
[b] The subsoil is a dark brown clay loam.
[c] The substratum is a reddish brown adobe clay.

TABLE 6.—*Comparative analyses of Tagaytay Ridge soil and soils of the Don Pedro (Central Azucarera) districts, Batangas.*[a]

Location of soil.	pH value.	Nitrogen (N).	Phosphoric anhydride (P_2O_5).	Potash (K_2O).	Lime (CaO).	Magnesia (MgO).
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Tagaytay Ridge	6.06	0.169	0.236	0.373	3.20	1.39
East Balayan	6.92	0.058	0.345	1.188	5.299	1.048
West Balayan	6.92	0.070	0.337	0.994	4.011	1.058
Nasugbu and Palico	7.04	0.100	0.330	0.823	2.852	1.006
Liang	7.12	0.098	0.362	0.753	3.285	0.907
Tuy	7.29	0.076	0.316	0.776	3.343	1.411

[a] Monthly Reports of the Research Bureau, Philippine Sugar Association 5 (1933) 367.

Danger of exhausting the plant food due to erosion processes and a careless cropping system is imminent, but careful husbandry will minimize the loss of fertility and preserve the usefulness of the soil.

SUMMARY

The soil reconnaissance made at Tagaytay Ridge covers an area of approximately 1,500 hectares. The soil type established in this area is Tagaytay sandy loam soil.

The surface, or A horizon, is very dark brown to nearly black in color; coarse granular in structure, and friable in consistency. It is volcanic in origin with a deposit that varies in thickness from 12 to 50 centimeters. The subsoil (B and B^1) horizon is very dark brown in color and varies from loam to clay. The substratum (C horizon) is reddish brown clay and coarse granular to adobe clay. The dark coloration of the surface soil is indicative of abundant organic matter, a fact verified by the chemical analysis.

The rolling topography of the land and the physical characteristics of the subsoil (friable in consistency, granular in structure, and low percolation rate) are favorable factors for soil erosion. The erosion process, however, will be minimized by careful husbandry of the soil.

The percentage of nitrogen in the soil is fairly high; the phosphoric anhydride and the potash are about normal. The pH reaction is slightly acidic.

The Tagaytay soil has sufficient potential plant-food constituents to produce a good yield of crops under favorable weather conditions, and this region would seem to be a good location for truck gardening on a large scale.

Baguio vegetables are now sold in the Manila markets. Tagaytay Ridge is more convenient than Baguio for raising produce to supply the Manila markets, for the distance from Manila to Tagaytay (78 kilometers) is much less than from Manila to Baguio (278 kilometers).

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ILLUSTRATIONS

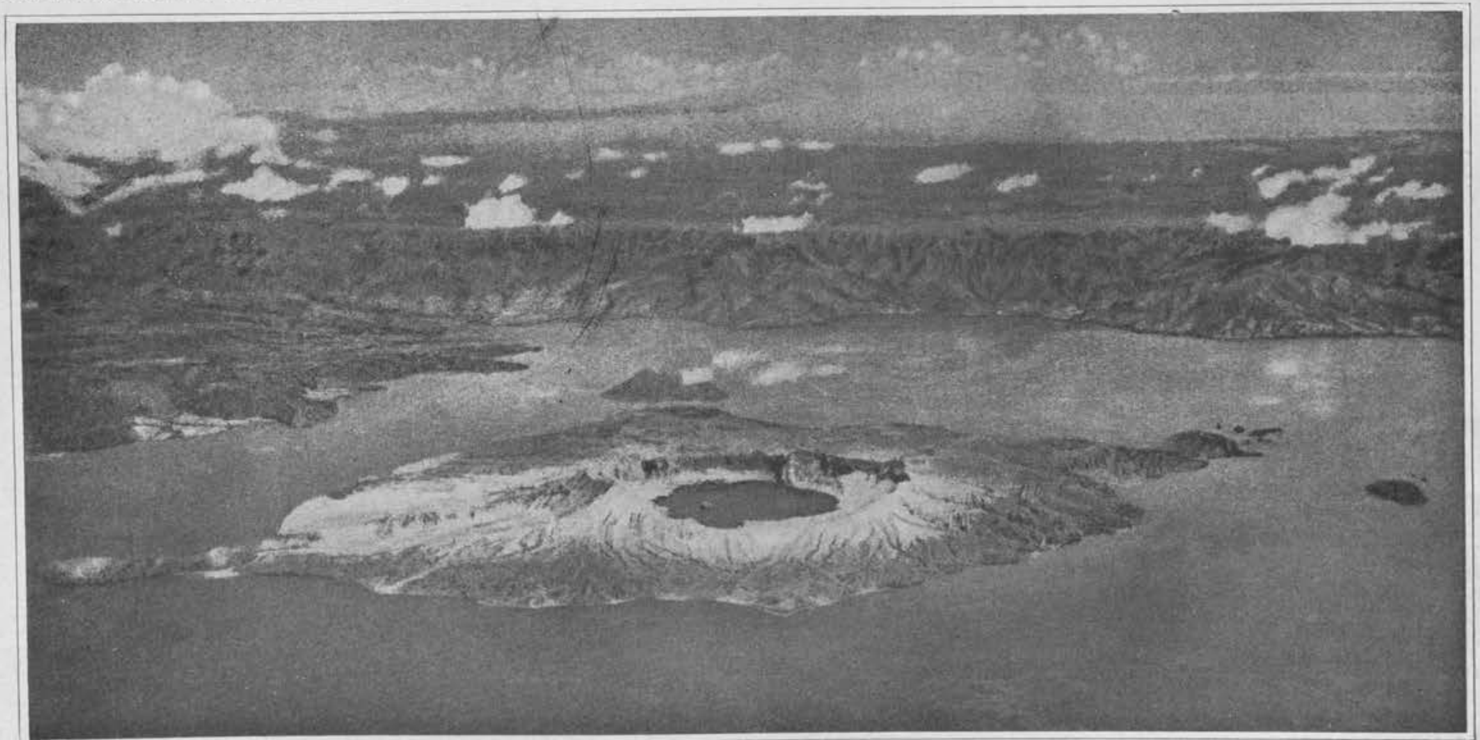

PLATE 1.

PRODUCTS FROM COCONUT-OIL WAX

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In the Philippine coconut-oil mills it is customary to store the oil in large tanks preparatory to shipment abroad. Sometimes the oil is allowed to remain in the tanks for some months. During storage a sediment gradually separates and is deposited on the bottom of the tank. Jakobsen[1] investigated a similar sediment that occurs in refined linseed oil and found it to be a wax.

A supply of the coconut-oil residue was obtained from one of the Philippine oil mills, and some preliminary experiments were carried out to ascertain if products of commercial value could be made from it.

EXPERIMENTAL PROCEDURE

Purification.—The crude residue, which contained a large amount of coconut oil, was purified in the following manner: The mixture was filtered through paper to remove most of the oil. The impure residue was placed in a flask and heated on a water bath (temperature, 80° C.) until most of the material melted. It was then filtered through a hot-water funnel to remove dust and other impurities. The residue was dissolved in hot kerosene; the solution was treated with decolorizing carbon (suchar) and filtered. The filtrate was treated with talcum powder, to remove particles of carbon. When the clear solution was cooled in ice water, white crystals separated out. These were removed by filtering and dried between layers of filter paper. The crystals were washed repeatedly with acetone in order to remove the last traces of kerosene. The melting point was 93° to 96° C.

The yield was not calculated, for the amount of solid material contained in samples of oily residue from different coconut-oil mills varied considerably. No definite information could be obtained as to the exact amount of residue that is deposited in the mill tanks as these data have never been ascertained. At one mill it was surmised that 500 tons of coconut oil stored for about three months would yield, perhaps, 40 kilos of sediment.

[1] Cotton Oil Press 6 (1922) 43.

At others where the oil was stored longer the estimates ran much higher.

Solubility.—Solubility experiments showed that the purified crystals dissolved readily in hot amyl alcohol, benzene, chloroform, isobutyl alcohol, isopropyl alcohol, propyl alcohol, and toluene. They are also fairly soluble in hot ethyl alcohol, but are only slightly soluble in benzyl alcohol, ethyl acetate, petroleum ether, methyl alcohol, ether, and acetone.

Constituents.—As stated later, when the purified crystals were decomposed (saponified) the reaction products were found to contain no glycerin. This coconut-oil residue is therefore not an ordinary fat (glyceride). Although it is insoluble in water, it has the property of forming emulsions with water. This would suggest that this material is a wax.

In order to get some idea as to the composition of the coconut-oil residue the refined material was first decomposed into its constituents by saponification. Ten grams were treated with potassium hydroxide (1.6 grams), dissolved in a few cubic centimeters of water, to which were added ethyl alcohol (15 cubic centimeters) and propyl alcohol (35 cubic centimeters). The mixture was heated on a water bath for two days to complete the reaction.

The saponified product was poured into large beakers and diluted with a large amount of water. The precipitate was removed by filtering, which was a rather slow process, washed well with water, dried between layers of filter paper, and crystallized from warm ether solution. The white crystals had a melting point of 88° to 90° C. They were almost insoluble in cold alcohol but dissolved readily in hot alcohol. These data indicated that these crystals consisted largely of myricyl alcohol.[2]

When the filtrate from the crystals containing myricyl alcohol was acidified with dilute sulphuric acid, there was obtained a flocculent white precipitate. This was separated by filtering, washed with water, and dried between layers of filter paper. When crystallized from hot chloroform, white crystals melting at 78° to 80° C. were obtained. The melting point indicated that these crystals consisted mostly of cerotic acid.[3]

The aqueous filtrate from the precipitated organic acid was evaporated to a small volume (about 12 cubic centimeters) and

[2] Lewkowitsch, J., Chemical Technology and Analysis of Oils, Fats and Waxes 1 (1921) 246.

[3] Op. cit. 1 (1921) 173.

tested for glycerin. The bisulphite test gave no acrolein odor and the silver-mirror test was also negative. These experiments show that the purified coconut-oil residue does not yield glycerin as a decomposition product and is, therefore, not a glyceride. This residue would appear to be a wax containing the myricyl ester of cerotic acid.

COMMERCIAL PRODUCTS

The basic material used for these preparations was the crude coconut-oil residue. This was filtered to remove most of the coconut oil. It was then melted and again filtered to eliminate dust and other impurities.

Floor wax.—The ingredients for this product were mixed in accordance with the following proportions:

Constituent.	Per cent.
Coconut-oil wax	32
Carnauba wax	15
Hercules rosin	3
Tallow	21
Turpentine	29
Total	100

The solid materials were melted together over a small flame. The flame was then extinguished and the turpentine and some coloring matter were added. The mixture was stirred thoroughly and poured into a container, which was stoppered tightly to prevent loss of solvent. The container was immersed immediately in ice water in order to solidify the mixture quickly as otherwise the ingredients tend to separate in layers.

The coloring matter was made by extracting a quantity of annatto seeds (*Bixa orellana* L.) with turpentine. The amount of dye solution to be added depends upon the color desired.

The consistency of the floor wax may be varied by combining the constituents in somewhat different quantities.

Furniture polish.—The materials were mixed in the proportions given below:

Constituent.	Per cent.
Stearic acid	7
Triethanolamine	2
Carnauba wax	21
Coconut-oil wax	11
Turpentine	26
Water	33
Total	100

The triethanolamine and the stearic acid were treated with the water and the mixture heated and stirred until it was uniform. The waxes were melted together and, after the addition of turpentine, the wax mixture was poured into the stearic acid solution previously prepared. The combined ingredients were stirred vigorously until the emulsion was homogeneous.

Polishes of this type may be used where a permanent finish is desired. They require considerable rubbing but produce a high luster.

Leather polish.—This contained the same materials as the furniture polish, but in different amounts.

Constituent.	Per cent.
Carnauba wax	7
Coconut-oil wax	4
Stearic acid	3
Triethanolamine	1
Turpentine	17
Water	68
Total	100

The stearic acid, triethanolamine, and water were mixed and heated until a uniform emulsion was obtained. The melted waxes containing turpentine were then added and the mixture stirred until rather cold.

The resulting product is cream-colored and suitable for polishing light-colored leathers. When treated with appropriate dyes this polish is suitable for dark-colored leathers.

When time permits, the chemistry of this waxy material, obtained from coconut oil, will be studied more in detail.

SUMMARY

During the storage of coconut oil a sediment gradually separates and is deposited on the bottom of the tank. When separated from foreign matter and purified this sediment is obtained as white crystals, which are soluble in various organic solvents.

Preliminary experiments showed that the purified coconut-oil residue does not yield glycerin as a decomposition product and is, therefore, not a glyceride. This residue would appear to be a wax containing the myricyl ester of cerotic acid.

Commercial products, such as floor wax and furniture and leather polishes, were prepared from this wax.

GLYCERINATED RINDERPEST VACCINE STORED AT ROOM TEMPERATURE [1]

By Teodulo Topacio

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Among the various types of wet rinderpest vaccine may be mentioned those of Kakizaki,(6, 7) Kakizaki et al.,(8) Boynton,(1) Kelser et al.,(9) Jacotot,(5) Curasson,(2) Curasson and Zylbertal,(3) and Evans(4) in which various chemicals were used as preservatives. The distemper vaccine of Laidlaw and Dunkin(10) and the fowl-plague vaccine of Todd(11) in a general way are prepared like the wet rinderpest vaccine. With the possible exception of Evans's rinderpest vaccine the others did not prove satisfactory in our hands when kept at local room temperature. Evans's, however, requires treatment for at least six to seven days before the product may be injected, which period corresponds to the time necessary to render the virus sufficiently attenuated or inert.

During the height of our campaign against rinderpest in the Philippine Islands some ten years ago, it was the experience that when mass vaccination was most urgently needed in order to halt the advance of an outbreak it was often difficult to provide the necessary quantity of vaccine at the desired moment. This was due mainly to the poor keeping qualities of the vaccine used then. The Boynton vaccine, for instance, requires from four to six weeks of storage before it can be tested. The Kelser vaccine, on the other hand, is ready for testing three days after preparation. Both vaccines, however, have the same disadvantage in that it is necessary to keep them on ice until they are injected; otherwise, they deteriorate quickly at room temperature. The vaccine to be described in this paper has all the advantages of rapid preparation and retains its protective power at room temperature for three months at least. Tests have not been made beyond this period.

[1] Bureau of Animal Industry Technical Bulletin 7. Received for publication May 6, 1935.

MATERIALS AND METHODS

The spleen and lymph glands of rinderpest animals were removed aseptically and treated in the manner employed in the preparation of the Kelser vaccine. The milled tissue pulp was strained without the addition of saline. The strained pulp was passed through a grinder of the type used for grinding corn for further trituration into much finer particles to the consistency of a soft paste. The concentration of tissue pulp was prepared in the proportion of 2 cc of tissue to 8 cc of 50 per cent glycerin-saline, 2.5 to 7.5, and 3 to 7 of the diluent, respectively. The mixture was shaken by hand in a bottle containing glass beads and infused in a Frigidaire at 0° to 5° C. for twenty-four hours. After the mixture had been strained through a double layer of gauze, formalin was added in a dilution of 1 to 1,000 by volume. It was next shaken in a motor-driven shaker for one to two hours and stored in a cool dark cabinet until ready for testing three days after preparation. Later, in the experiments, the shaking period was reduced from three to ten minutes daily for three successive days. Storage was maintained at room temperature throughout the testing periods (20 ° to 30 ° C.).

Safety tests.—Small-animal inoculations of the fourteen batches of vaccine proved satisfactory, no animal having shown undesirable effects. In cultural tests four lots were found to be completely sterile within a month. At no time was any dangerous contamination observed.

Potency tests.—Highly susceptible native cattle were employed for testing the potency of each lot of vaccine as in the case of the Kelser vaccine.

Dosage and route of inoculation.—Each lot was tested by injecting a single dose of 10 cc per animal intramuscularly in the muscle of the back behind the shoulder as in the method of administration of the Kelser vaccine. At the end of fourteen days 1 cc of whole virulent blood was given each test animal together with one or two susceptible animals as controls.

Concentration of tissue and storage.—In the lots of vaccine under consideration the first six lots contained 2 parts of tissue by volume to 8 parts of diluent. In lots 7 to 10 the proportion was 3 to 7, while in lots 11 to 14 it was 2.5 to 7.5. All the vaccines were kept at room temperature while they were being tested. The period of testing varied from three days to three months after preparation, during which time the vaccines were constantly kept at room temperature (20° to 30° C.).

TESTS OF FOURTEEN LOTS OF VACCINE

Vaccine 1.—Fuga animal 3101 received 10 cc of lot 9, seven days old, in the muscle of the back. No reaction followed the injection of a test dose of 1 cc virulent blood. Romblon animal 86 received the same amount of vaccine, one month old, and again no reaction followed the test injection of virulent blood. Fuga animal 3256 received a dose of the same material, three months old. The test injection of virus produced only a mild temperature reaction in this animal.

Vaccine 2.—This lot was prepared in the same manner as the preceding lot. Mindoro animal 108 was injected with 10 cc of the vaccine, nine days old, and Fuga animal 3274 received a similar dose of the vaccine, two months old. Both animals completely resisted a dose of 1 cc virulent blood with no reaction whatever, showing that they were fully protected.

Vaccine 3.—Fuga animal 3242 was inoculated with 10 cc of vaccine, three days old, and Fuga animal 3272 received the same dose of vaccine, one month old. The injection of 1 cc virulent blood caused only a thermal reaction without clinical symptoms.

Vaccine 4.—Fuga animal 3247 received 10 cc of vaccine, three days old, and Fuga animal 3414 was given the same amount of vaccine two months later. The first animal showed a thermal reaction to the test dose of 1 cc virulent blood, while the second developed rinderpest and was killed for rinderpest vaccine.

Vaccine 5.—Fuga animal 360 was injected with 10 cc of the vaccine, three days old, while Fuga animal 3412 received the same dose of the vaccine two months later. When both were given the test dose of virulent blood, the first showed a thermal reaction; the other developed rinderpest symptoms and was killed for vaccine.

Vaccine 6.—Fuga animal 383 received 10 cc of the vaccine, four days old, and Fuga animal 3418 received the same amount of the vaccine two months after preparation. The first animal showed no reaction to the virus test, while the other developed clinical rinderpest and was killed for vaccine.

Vaccine 7.—Three days after preparation this vaccine was injected into Fuga animal 402 in the standard dose. Fuga animal 3398 received the same vaccine when it was two months old. The first animal presented no reaction to the virus test, while the second showed a slight temperature reaction only, showing that both were immune.

Vaccine 8.—Fuga animal 3263 received a dose of vaccine three days old. Fuga animal 3406 was injected with the standard dose one month after preparation. After a test dose of virulent blood the first animal showed no signs of disease whatever, while the other presented a temperature response. This animal was originally in poor condition before it was given the injection.

Vaccine 9.—Fuga animal 403 received a dose of vaccine three days old, and Fuga animal 3410 a dose of the same material two months later. A test dose of virus produced no effect on the first animal, while the second animal developed rinderpest and was killed for vaccine.

Vaccine 10.—Fuga cattle 3251 and 3420 each received the standard dose of the vaccine three days and two months old, respectively. A test dose

of virulent blood a fortnight later produced a slight temperature reaction in the first animal and clinical rinderpest in the other, but the animal completely recovered.

Vaccine 11.—Fuga cattle 3417 and 3402 each received the standard dose of vaccine three days and one month old, respectively. The virulent blood injection gave no reaction to the first, and rinderpest symptoms in the other were followed by uneventful recovery.

Vaccine 12.—Fuga cattle 3423 and 3401 both were inoculated with the standard dose of the vaccine four days and one month, respectively, after its preparation. The test virus elicited no reaction in the first animal, while the second animal showed a temperature reaction. Both animals were completely protected.

Vaccine 13.—Fuga cattle 3261 and 3409 each received the standard dose of the vaccine three days and one month old, respectively. No reaction resulted after the test dose of the virulent blood, showing that a solid immunity was conferred upon both animals.

Vaccine 14.—Fuga cattle 3407 and 3411 were injected with 10 cc of the vaccine three days and one month old, respectively. At the end of fourteen days they were given the standard dose of virulent blood subcutaneously. The first animal presented no symptoms whatever, and the other responded by having a thermal reaction only.

The accompanying table summarizes in detail the tests made on the fourteen lots of vaccine just described:

TABLE 1.—*The tests of fourteen lots of vaccine and the results.*[a]

Animal No.	Vaccine No.	Concentration.	Age of vaccine.		Date injected.	Dose.	Virus (C.V.B.).[b]	Date injected.	Result.
			Mos.	*days*	1934	*cc.*	*cc.*	1934	
3101	1	2:8	0	7	Mar. 31	10	1	Apr. 13	No reaction.
86	1	2:8	1	0	Apr. 23	10	1	May 9	Do.
3256	1	2:8	3	0	June 29	10	1	July 13	Temperature reaction.
108	2	2:8	0	9	May 7	10	1	May 23	No reaction.
3274	2	2:8	2	0	July 7	10	1	July 20	Do.
3242	3	3:8	0	3	May 28	10	1	June 13	Temperature reaction.
3272	3	3:8	1	0	June 30	10	1	July 13	Do.
3247	4	3:8	0	3	June 12	10	1	June 27	Do.
3414	4	3:8	2	0	Aug. 9	10	1	Aug. 22	Killed for vaccine.
360	5	3:8	0	3	June 29	10	1	July 13	Temperature reaction.
3412	5	3:8	2	0	Aug. 16	10	1	Aug. 29	Killed for vaccine.

[a] Controls: Each vaccine test was accompanied by one or two controls, which developed typical rinderpest, and were killed for vaccine six days after virus inoculation without exception.

TABLE 1.—*The tests of fourteen lots of vaccine and the results*—Continued.

Animal No.	Vaccine No.	Concentration.	Age of vaccine.		Date injected.	Dose.	Virus (C.V.B.).[b]	Date injected.	Result.
			Mos.	*days*	1934	*cc.*	*cc.*	1934	
383	6	3:8	0	4	July 6	10	1	July 20	No reaction.
3418	6	3:8	2	0	Aug. 16	10	1	Aug. 29	Killed for vaccine.
402	7	3:7	0	3	July 11	10	1	July 25	No reaction.
3398	7	3:7	2	0	Sept. 9	10	1	Sept. 26	Slight temperature reaction.
3263	8	3:7	0	3	July 17	10	1	Aug. 1	No reaction.
3406	8	3:7	2	0	Sept. 17	10	1	Oct. 10	Temperature reaction (week animal?).
403	9	3:7	0	3	July 26	10	1	Aug. 8	No reaction.
3410	9	3:7	2	0	Sept. 26	10	1	Oct. 10	Killed for vaccine.
3251	10	3:7	0	5	Aug. 8	10	1	Aug. 22	Temperature reaction.
3420	10	3:7	1	24	Sept. 27	10	1	Oct. 10	Recovered.
3417	11	2.5:7.5	0	5	Aug. 16	10	1	Aug. 29	No reaction.
3402	11	2.5:7.5	1	0	Sept. 11	10	1	Sept. 26	Recovered.
3423	12	2.5:7.5	0	4	Aug. 16	10	1	Aug. 29	No reaction.
3401	12	2.5:7.5	1	0	Sept. 14	10	1	Oct. 3	Temperature reaction.
3261	13	2.5:7.5	0	3	Aug. 27	10	1	Sept. 12	No reaction.
3409	13	2.5:7.5	1	0	Sept. 22	10	1	Oct. 10	Do.
3407	14	2.5:7.5	0	3	Aug. 30	10	1	Sept. 19	Do.
3411	14	2.5:7.5	1	0	Sept. 27	10	1	Oct. 10	Temperature reaction.

[b] Concentrated whole virulent blood.

In the above table the résumé of results shows that of the twenty-nine animals employed in the tests only four, which developed severe rinderpest symptoms, were killed for vaccine. The total protection value of the vaccines was, therefore, 86.2 per cent.

DISCUSSION

Mention was made of the different wet vaccines prepared by contemporary workers on rinderpest. None of them had proven satisfactory at room temperature in our hands because their potency diminished rapidly, with the possible exception of Evans's vaccine, which according to his claim was still protective up to nineteen weeks after preparation when kept at tropical room temperature. However, his experiments were rather too limited to permit a safe deduction. Moreover, one week was

required before the vaccine could be completely attenuated for safe inoculation. With the glycerinated vaccine described in this paper attenuation is complete in three days, which is a decided advantage in its favor. The final result of testing the fourteen batches, summarized in Table 1, indicated that the vaccine was efficient as a satisfactory immunizing agent against rinderpest in the three concentrations employed. It is of particular interest to note that the concentration of tissue in vaccines 10 to 14 probably approached the ideal as far as potency was concerned, since all the test animals employed resisted successfully the test dose of virulent blood, giving a protection value of 100 per cent. Admittedly the number of lots of the vaccines tested is limited, but the results obtained were highly satisfactory with regard to potency and keeping qualities at room temperature.

The most notable feature about the vaccine in these experiments is the fact that in all the first tests of each lot solid immunity was conferred upon all the animals inoculated, so that it seems safe to assume that, at least within the first month after preparation, potency is almost absolute. Of fourteen animals used in the first test, four animals showed temperature reaction following the test dose of virulent blood. This variation, however, in antigenicity is regularly observed in tissue vaccines of this nature, because no two animals produce organ antigens of exactly the same titre. The same may be said of each separate brew of vaccine (for example, vaccines 4 and 5). This is unavoidable unless the antigenic index of the organs from each animal used for vaccine could be estimated beforehand by some reliable test whereby organs of high and low antigenic titres could be adjusted in proportionate amounts so as to permit standardization of potency of the final product. Under the circumstances, absolute standardization of antigenic unit is extremely difficult if not impossible, and results must be viewed in a relative sense in consonance with the varying capacity of each animal to develop antigenic principles in its organs utilized for making the vaccine.

SUMMARY

1. A glycerinated rinderpest vaccine capable of storage at local room temperature is described.

2. The vaccine is of high immunizing value as shown by the fact that 86.2 per cent of all the animals vaccinated resisted successfully the test dose of virulent blood.

3. The chief advantage of this vaccine lies in the rapidity of its preparation and its keeping quality at local room temperature (20° to 30° C.).

4. There is evidence that with better care in technic this vaccine can be rendered bacteria-free one month after preparation, since in four series it was found to be sterile within this period even with the ordinary aseptic methods of handling the materials.

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THE PASTEUR ANTIRABIC TREATMENT AT THE BUREAU OF SCIENCE, MANILA

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The object of this paper is to report the results of the Pasteur treatment as carried out at the Bureau of Science, Manila, Philippine Islands. The report includes all the cases treated since the institution of antirabic treatment in the Philippines nineteen years ago; that is, from April 23, 1914, to December 31, 1933.

TYPES OF VACCINE EMPLOYED

On the first page of the book used for recording the cases reporting for Pasteur treatment, Dr. E. W. Ruediger, who initiated the prophylactic treatment of rabies in the Philippines, wrote the following information: "The strain of rabies vaccine (fixed virus of rabies) was obtained from the Pasteur Institute in Saigon. The method of application is a slight modification of that described by Otto Lentz, Deutsche medizinische Wochenschrift, (1910), 36, 1257." The same strain is being used at the present time. From 1914 to 1927, inclusive, the vaccine employed was prepared from 3-day cords that were ground up and emulsified in 0.5 per cent phenolized physiologic salt solution and diluted in such a way that 0.5 cc of the emulsion represented a certain length of the cord; namely, 0.25 to 0.5 cm. After that time a 1 per cent emulsion of fresh rabid brains and cord in carbolized salt solution has been used. In both cases the method of administration was the same, the following doses being employed for adults:

Day.	cc.	Day.	cc.
First	0.5	Fourteenth	1.0
Second	1.0	Fifteenth	1.5
Third	1.5	Sixteenth	1.0
Fourth	0.5	Seventeenth	1.5
Fifth	1.0	Eighteenth	1.0
Sixth	1.5	Nineteenth	1.5
Seventh	0.5	Twentieth	1.0
Eighth	1.0	Twenty-first	1.5
Ninth	1.5	Twenty-second	1.5
Tenth	0.5	Twenty-third	1.0
Eleventh	1.0	Twenty-fourth	1.5
Twelfth	1.5	Twenty-fifth	1.5
Thirteenth	0.5		

To children under 5 years of age one-half of the adult dose and to children from 5 to 10 years three-fourths of the adult dose was given. Twenty-five injections constitute a complete course of Pasteur treatment.

RESULTS OF TREATMENT

From April 23, 1914, to December 31, 1933, inclusive, the total number of cases treated was 17,858, of which 11,345, or 63.53 per cent, were males, and 6,513, or 36.47 per cent, females. Nine thousand three hundred thirty-nine (9,339) cases, or 52.30 per cent, received complete treatment, and 8,519 cases, or 47.70 per cent, incomplete treatment. Of all the cases 17,609, or 98.61 per cent, were bitten by dogs, and the remaining, less than 2 per cent, by other animals. Of the total number of cases 16,682 were Filipinos, 975 Europeans and Americans, 112 Chinese, 83 Japanese, 5 Hindus, and 1 Negro. The deaths recorded resulted from dog bites and occurred only among Filipinos, this death rate being 0.0243 per cent, or 4 deaths, among the 16,459 Filipinos bitten by dogs. In computing the death rate, only the hydrophobia cases that took complete treatment and died later than fifteen days after the completion of the treatment have been considered. If the computation is based only on the number of those cases (8,150) that received complete treatment for dog bites, Filipinos only being considered, the death rate would be a little higher; namely, 0.049 per cent. Taking all the cases of dog bites among Filipinos—namely, 16,459, regardless of the kind of treatment received—there were in all 14 deaths, or a death rate of 0.085 per cent. Of these 14 cases, 11, or 78.57 per cent, were males and 3, or 21.43 per cent, were females.[1]

PROBABILITY OF RABIES IN THE BITING ANIMAL

The biting animals have been classified into four categories; namely, A, not suspected of rabies; B, suspected of rabies; C, proved rabid; D, certified rabid.

Category A includes all those cases in which the condition of the biting animal was apparently normal. In group B are included all cases in which, according to popular observation, the

[1] "In accordance with the resolution of the International Rabies Conference, all deaths, whether occurring during treatment or after its termination, are to be included in the schedules." League of Nations Quarterly Bulletin of the Health Organization 2 No. 4 (December, 1933). A. G. McKendrick. See Tables 1 to 4.

biting animal was rabid. In this connection it may be stated that many people in the Philippines are well acquainted with the symptoms of rabies in dogs. In category C are placed those animals in the brains of which Negri bodies were found. In category D the animals were certified rabid by competent veterinarians.

The biting animals in 75 per cent of those cases that developed hydrophobia later than fifteen days after the completion of treatment belonged to category B (suspected of rabies) and in 25 per cent to category A (not suspected of rabies). All of the cases that developed hydrophobia within fifteen days after the completion of treatment were bitten by animals belonging to category B (suspected of rabies). In two-thirds of the cases developing hydrophobia during treatment, the biting animals belonged to category A (not suspected of rabies). This is an observation worth emphasizing, as it shows how dangerous it is to forego Pasteur treatment in cases in which the biting animal is apparently normal. In the remaining one-third of the cases the biting animals belonged to category B (suspected of rabies). In those cases that received only a few injections (3 to 12 injections) and developed hydrophobia afterwards, the biting animal in two-thirds of such cases belonged to category B (suspected of rabies), while in the remaining one-third the biting animals belonged to category A (not suspected of rabies). Of the cases that developed hydrophobia, irrespective of whether treatment was complete or incomplete, 57.14 per cent were bitten by dogs belonging to category B (suspected of rabies) and 42.86 per cent by dogs belonging to category A (not suspected of rabies). No deaths from hydrophobia occurred in persons bitten by animals belonging to groups C (proved rabid) and D (certified rabid). This was probably due to the fact that the individuals concerned were advised by veterinarians to take early and complete Pasteur treatment.

INCUBATION PERIOD

Of the fourteen cases that developed hydrophobia 14.28 per cent came down with symptoms of the disease within the first month; that is, on the thirteenth and twentieth day after the bite; in 50 per cent of the cases rabies showed itself within two months, in 85.71 per cent within three months, and in 7.14 per cent within four to six months. Striking an average for all the cases, the incubation period was fifty-four days (Tables 1 to 4).

TABLE 1.—*Cases developing hydrophobia later than fifteen days after completion of treatment (failures).*

Year.	Case No.	Serial No.	Sex.	Age.	Animal.	Bite site.	Days late.	Injections.	Incubation period.
				Yrs.					*Days.*
1920	1607	1	Male	5	Dog (suspected of rabies).	Trunk	46	25 (from April 9 to May 14, somewhat irregular).	164
1925	4840	2	Female	55	do	Foot	0	25 (daily)	58
1929	8932	3	do	43	do	do	0	do	67
1930	1165	4	Male	12	Dog (not suspected of rabies).	Arm (arm and chest)	0	23 (daily)	107

TABLE 2.—*Case developing hydrophobia within fifteen days of completion of treatment.*

Year	1926
Case No.	6232
Serial No.	1
Sex	Male.
Age, years,	21
Animal	Dog (suspected of rabies).
Bite site	Arm (arm and chest).
Days late	5
Incubation period, days,	41
Total daily injections	25

TABLE 3.—*Cases developing hydrophobia during treatment.*

Year.	Case No.	Serial No.	Sex.	Age.	Animal.	Bite site.	Days late.	Injections.	Incubation period.
				Yrs.					*Days.*
1919	1475	1	Male	14	Dog (suspected of rabies).	Head (face).	2	11	13
1928	8537	2	do	5	Dog (not suspected of rabies).	Arm (deep lacerated wound on upper arm).	2	14	20
1931	12759	3	Female	5	do	Arm	2	[a] 7	32

[a] July 24, August 18, 19, 20, 21, 22 last injection double dose.

TABLE 4.—*Cases that took only a few antirabic injections and then quit and later developed hydrophobia.*

Year.	Case No.	Serial No.	Sex.	Age.	Animal.	Bite site.	Days late.	Incubation period.	Injections.
				Yrs.				*Days.*	
1919	1379	1	Male	19	Dog (suspected of rabies).	(?)	2	60	3
1922	2759	2	do	12	do	Arm (arms)	3	30	12
1922	3253	3	do	21	do	Head (face and head).	3	46	8
1926	556	4	do	6	Dog (not suspected of rabies).	Head (face)	0	50	6
1928	8503	5	do	6	Dog (suspected of rabies).	Head (face and arm).	1	55	8
1929	9557	6	do	4	Dog (not suspected of rabies).	Head (face, head, trunk)	2	77	4

LATENESS OF ARRIVAL FOR TREATMENT

It may be noted that the longest incubation period, which is one hundred sixty-four days, among our cases of hydrophobia was observed in a patient who reported for Pasteur treatment forty-six days after being bitten by a dog that was suspected of rabies (case 1607, serial case No. 1, Table 1). If in the group of persons that received complete treatment (Table 1) only the three cases that came for Pasteur treatment within the first twenty-four hours after the bite are considered, the average incubation period for such cases would be seventy-four days, which is even shorter than the incubation period of seventy-seven days observed in case 9557, Serial No. 6, Table 4, who reported two days after having been bitten by a dog not suspected of rabies and who received only four antirabic injections. Although it is realized that there exist differences in the virulence of street virus as well as in the degrees of susceptibility and resistance of individuals, the results, as pointed out above, are rather disconcerting. However, the hydrophobia cases here considered are too few to justify any conclusion.

LOCATION OF BITES

The classification recommended by the Paris Conference on Rabies under the auspices of the League of Nations has been followed in describing the location of the bites.

"Head," "Arm," "Trunk," and "Leg" indicate bites on these parts, multiple bites having been classed according to the site of greatest danger. "Unknown" means that the site of the bite was not mentioned in the case records. Considering only the fourteen cases of the series that developed hydrophobia, the locations of the bites were as follows:

	Per cent.
Head	35.714
Arm	35.714
Trunk	7.143
Leg	14.286
Unknown	7.143

Considering the total number of cases treated, the bite sites were as follows:

	Per cent.
Head	7.46
Arm	29.69
Trunk	7.71
Leg	52.06
Unknown	1.61
Contacts	1.47

AGE OF THE PATIENTS

Of the fourteen cases that developed hydrophobia, six, or 42.85 per cent, were under 9 years of age; four, or 28.57 per cent, were between 10 and 19 years of age; two, or 14.29 per cent, ranged from 20 to 30 years; and two, or 14.29 per cent, were above 30 years of age.

UNTOWARD EFFECTS OF TREATMENT

Paralytic accidents.—Postvaccination paralysis has never been observed among our cases. In this connection the following observations may be recorded. By inoculating a series of rabbits intradurally with emulsions of one-day, two-day, and three-day cords obtained from rabid rabbits that had been inoculated with fixed virus, it was observed that the one- and two-day cords sometimes produced rabies in the inoculated rabbits, whereas the three-day cords never produced the disease in the inoculated animals. This probably explains the absence of postvaccination paralysis in our cases treated according to the method of Pasteur but using only three-day cords, as observed elsewhere in this paper. With the dilute carbolized vaccine, which has been used at the Bureau of Science since 1928, the dilution and the phenolization of the vaccine probably so alter the virus that it is rendered incapable of producing paralysis.

Anaphylactic manifestations.—The majority of the cases had no complaints to make. Children as young as 1.5 months old and people as old as 110 years have taken the treatment without showing any ill effects. There were two young women, however, who, a few minutes after receiving the first injection experienced great prostration and general malaise. The symptoms, however, disappeared rapidly and never recurred during the course of the treatment. Two other cases developed urticaria following the first injection, and both refused to have the treatment continued because in their opinion it was the cause of the urticaria. On the other hand, several of the cases here reported received complete Pasteur treatment on as many as three different occasions and did not manifest the least sign of anaphylaxis. In a few instances, especially in children, the patients gained in weight and improved in general health during the course of the treatment.

Other manifestations.—A few of the patients experienced general malaise during the entire course of the treatment. The examination of the urine of these cases revealed the presence of albumin and tube casts.

COMPARISON OF METHODS OF TREATMENT EMPLOYED

From 1914 to the end of 1927, the vaccine used for Pasteur treatment was prepared from three-day cords. During this period there were treated 6,266 cases bitten by dogs, of which 5,716 were Filipinos, and 8 of them (Filipinos) developed hydrophobia. Only 3,450 of the Filipinos bitten by dogs took complete treatment, and of the 8 that developed hydrophobia only 3 took complete treatment, giving a death rate of 0.08 per cent.

From 1928 to 1933 carbolized vaccine was used. During this period there were treated 11,343 cases bitten by dogs, of which 10,743 were Filipinos and 6 of them (Filipinos) developed rabies. Only 4,700 of the Filipinos bitten by dogs took complete treatment, and of the 6 cases that developed hydrophobia only 2 received complete treatment, giving a death rate of 0.04 per cent. The figures show that with the use of the dried cord the incidence of hydrophobia was twice as great as with the use of carbolized rabid brain emulsion.

SUMMARY

The total number of cases given Pasteur treatment at the Bureau of Science from 1914 to 1933, a period of nineteen years, is 17,858. Of these 52.30 per cent were males and 47.70 per

cent females. Classified according to age, 35.42 per cent of the patients were children up to 9 years of age; 29.50 per cent were from 10 to 19 years; 16.58 per cent were 20 to 30 years; and 18.50 per cent were above 30 years of age.

In 94.90 per cent of the cases the implicated animals were not suspected of rabies; in 4.10 per cent they were suspected of rabies; in 0.55 per cent they were proved rabid; and in 0.45 per cent they were certified rabid.

In 7.46 per cent of the cases the bites were inflicted on the head, in 29.69 per cent on the arm, in 7.71 per cent on the trunk, in 52.06 per cent on the leg, and in 1.61 per cent of the cases the site of the bite was not specified. The rest of the cases (1.47 per cent) were contacts only; that is, they were not actually bitten, but they only came in contact with, or were licked by, the implicated animals.

In 98.61 per cent of the cases the implicated animals were dogs, the rest (1.39 per cent) included cats, monkeys, horses, pigs, rats, rabbits, and human beings.

Of the total number of patients 18.51 per cent reported within the first twenty-four hours after being bitten, 56.38 per cent in from one to two days, and 25.11 per cent later than three days after the infliction of the bite.

Patients coming to the Bureau of Science for Pasteur treatment are adviced to report daily until they have received the complete treatment of twenty-five injections of rabies vaccine. In spite of this, however, the records show that 52.30 per cent of the cases took the complete treatment, the remaining 47.70 per cent receiving only from one to fourteen injections.

The percentage of mortality was 0.049 per cent. In computing the mortality only those cases that took complete treatment and died later than fifteen days after completion of the treatment have been considered.

An analysis of the incubation period in the cases that developed hydrophobia later than fifteen days after the completion of the treatment has failed to indicate any tendency for the mortality to increase with lateness of arrival for treatment. Neither does the site of the bite seem to have influenced the length of the incubation period.

A comparison of the efficiency of the two types of vaccine employed brings out the fact that with the use of the three-day cord the incidence of hydrophobia among the cases was twice as great as with the use of the carbolized vaccine.

TWO MORE NEW HETEROPHYID TREMATODES FROM THE PHILIPPINES

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ONE PLATE

In a previous paper, which is still in press, we have described three new species of flukes of the family Heterophyidæ Odhner, 1914, two from dog and one from man and reported the occurrence of several hitherto unknown members of this group in these two hosts in the Philippines. On extending our investigation further, we found two more new species of this group representing two genera; namely, *Monorchotrema* Nishigori, 1924, and *Apophallus* Lühe, 1909. For the first trematode the name *Monorchotrema calderoni* is proposed in honor of Prof. Fernando Calderon, dean of the College of Medicine and director of the School of Hygiene and Public Health, University of the Philippines, and for the second the name *Apophallus eccentricus* is proposed on account of the eccentric position of the genital pore.

MONORCHOTREMA CALDERONI sp. nov. Plate 1, fig. 1.

The following description is based on the study of a considerable number of the 137 specimens of this fluke obtained from dogs on four occasions in parasitic association with *Heterophyes expectans* Africa and Garcia (1935), *Monorchotrema taichui* Nishigori, 1924, and *Apophallus eccentricus,* a new species herein described. In this connection we might mention that we encountered previously in autopsies of man and dog both *Monorchotrema taichui* and *Monorchotrema taihokui.*

Body very small, 0.47 to 0.48 mm by 0.25 to 0.26 mm, pear-shaped, covered with scalelike spines. Oral sucker subterminal, 0.05 mm in diameter; acetabulum absent; prepharynx short; pharynx globular, 0.03 mm in diameter; œsophagus long and capillary; intestinal cæca simple tubes running close to the sides of the fluke and extending to near the posterior end of the body.

Female organs.—Ovary globular, 0.055 to 0.057 mm in diameter, close to the median line, between the genital sac and the testis but closer to the former; receptaculum seminis large, globular, 0.103 by 0.073 mm, situated on the left side of the body between the testes and the ovary; the oviduct runs posteriorly from the ovary to meet the short duct from the receptaculum seminis and the descending stem of the uterus in the median line; the uterus descends at the right side and after making several loops in the posterior half of the body, ascends at the left side along the left cæcum towards the genital sac where it ends in common with the ejaculatory duct into the genital pore; the vitellaria are composed of large isolated follicles with median distribution in front of the testis.

Male organs.—The single large spherical testis, 0.225 mm in diameter, occupies the median field of the posterior third of the body; the seminal vesicle situated opposite to the receptaculum seminis, consists of two very unequal parts, the first a small globular sac separated from the larger, very much longer anterior or expulsor portion, by a short constriction. The anterior or expulsor portion is an enormous cucumberlike cylindrical organ, 0.23 by 0.035 mm, which runs posteroanteriorly along the inner curvature of the right cæcum towards the genital sac, which in 80 per cent of the specimens, is located in the median line almost immediately behind the bifurcation of the œsophagus. The gonotyl, which is provided with an incomplete circlet of very minute spines, completely fills the genital sac.

The excretory bladder is Y-shaped.

Eggs, 0.021 to 0.022 mm by 0.011 to 0.012 mm.

Specific diagnosis.—*Monorchotrema:* Body small, 0.47 to 0.48 mm by 0.25 to 0.26 mm, pear-shaped, covered with scalelike spines; prepharynx short; œsophagus long and capillary; oral sucker subterminal, 0.05 mm; ventral sucker absent; single testis (0.225 mm in diameter) at posterior end of body; ovary in front of testis; seminal receptacle between testis and ovary; seminal vesicle consists of two very unequal portions, the anterior or expulsor portion powerfully developed, very prominent and cucumberlike in shape; vitellaria lie at posterior part of the body, mostly median; uterus coils at sides of testis and in front of it; genital sac as a rule in median line, close behind the bifurcation of the œsophagus, containing a large gonotyl which bears an incomplete circlet of very fine spines; excretory vesicle Y-shaped; eggs 0.021 to 0.022 mm by 0.011 to 0.012 mm.

Host.—Dog.

Location.—Small intestine.

Locality.—Biñan, Laguna Province, Luzon.

Type specimen.—Parasitological collection, School of Hygiene and Public Health, University of the Philippines.

Remarks.—Hitherto four species of the genus *Monorchotrema* Nishigori, 1924, have been described; namely, *Monorchotrema taichui* Nishigori, 1924, *M. taihokui* Nishigori, 1924, *M. microrchia* Katsuta, 1932, and *M. yokogawai* Katsuta, 1932. *Monorchotrema calderoni* is more closely related to *M. microrchia* than to any other member of the genus. However, it differs from the latter in the following points: (1) The body of *Monorchotrema calderoni* is distinctly pear-shaped, while in *M. microrchia* it is elongate, (2) the genital sac of *M. calderoni* is close to, or immediately behind, the bifurcation of the œsophagus and median in position in the majority of specimens, while in *M. microrchia* it is farther down from the œsophageal bifurcation and eccentrically placed, (3) the expulsor portion of the seminal vesicle in *M. calderoni* is cucumber-shaped, very prominent and enormously long, while in *M. microrchia* the expulsor is short, saclike, and not as prominent.

APOPHALLUS ECCENTRICUS sp. nov. Plate 1, fig. 2.

Body elongated, 2.15 by 0.35 mm, greatest width at the level of the testes; cuticle covered with scalelike spines. Oral sucker subterminal, 0.09 mm in diameter; prepharynx longer than œsophagus; pharynx squarish, 0.05 by 0.05 mm with biconcave sides; bifurcation of œsophagus closer to the ventral sucker than to the oral sucker; intestines slender, extending to near the posterior end of the body. Acetabulum 0.055 mm in diameter, preëquatorial at the junction of the anterior and middle thirds of the body, and opening into the genital sinus. Genital pore at the left lateral end of the genital sinus, the aperture being guarded by two crescentic papillalike gonotyls, 0.03 by 0.012 mm.

Female organs.—Ovary globular, 0.12 mm in diameter, on right side of the body about midway between acetabulum and anterior testis; behind it is the ovoid receptaculum seminis, 0.09 by 0.06 mm. The uterine coils are not confined to the intercæcal space, but liberally spread between the acetabulum and the most posterior end of the body. The vitellaria are composed of large follicles, confluent posteriorly but not anteriorly, extending from the posterior end to the level of the ovary, never beyond.

Male organs.—Testes roughly globular, placed obliquely one behind the other, considerably removed from the posterior end of the body, the anterior or left testis usually the smaller, 0.25 by 0.2 mm, the posterior one 0.3 by 0.29 mm. The seminal vesicle consists of several portions, which form an S-shaped organ directly behind the acetabulum, except the expulsor portion which swerves to the left side to join the vagina before opening into the genital pore.

Eggs, 0.022 by 0.012 mm.

Specific diagnosis.—*Apophallus:* Body elongated, 2.5 by 0.35 mm, greatest width at the level of the testes; cuticle covered with scalelike spines; prepharynx longer than œsophagus; intestinal bifurcation closer to acetabulum than to oral sucker; intestines slender, extending to near posterior end of body, acetabulum preequatorial at junction of anterior and middle thirds of body and opening into genital sinus; genital pore eccentrically located at left lateral end of genital sinus on same level with acetabulum, and guarded by two crescentic papillalike gonotyls; ovary globular, 0.120 mm in diameter, on right side of body about midway between acetabulum and anterior testis; uterine coils not confined to the intracæcal space and liberally spread between acetabulum and posterior end of body; vitellaria composed of large follicles, confluent posteriorly but not anteriorly, never extending beyond the ovary anteriorly; testes roughly globular, obliquely one behind the other, considerably removed from the posterior end of body, the right or posterior testis being the larger, 0.3 by 0.29 mm, the left or anterior testis, 0.25 by 0.2 mm, the seminal vesicle composed of several portions separated by constrictions having an S-shaped organ directly behind the acetabulum.

Host.—Dog.

Location.—Small intestine.

Locality.—Biñan, Laguna Province, Luzon.

Type specimen.—Parasitological collection, School of Hygiene and Public Health, University of the Philippines.

Remarks.—The species that have been assigned to the genus *Apophallus* by previous writers are as follows: *Apophallus muhlingi* (Jägerskiöld, 1899) Lühe, 1909 (type of genus); *A. brevis* Ransom, 1920; *A. major* Szidat, 1924; and *A. crami* Price, 1931. According to Witenberg (1929), *A. major* is a synonym of *A. muhlingi*, and *A. brevis* a synonym of *Rossicotrema donicum* Skrjabin, 1919. Price (1931), on the other hand, claims that

A. brevis should be regarded as a distinct species, at least until more material is available for study, and opines further that it stands closer to *A. muhlingi* than to *R. donicum*. *Apophallus eccentricus* differs from either *A. muhlingi* or *A. crami* principally in the following points:

1. In *A. eccentricus* the prepharynx is longer than the œsophagus, while in both *A. muhlingi* and *A. crami* the œsophagus is several times longer than the prepharynx.
2. In *A. eccentricus* the genital pore is on the left lateral end of the genital sac, while in both *A. muhlingi* and *A. crami* this organ is at the anterior end.
3. In *A. eccentricus* the ventrogenital apparatus is situated a considerable distance anteriorly to the middle of the body, or at the junction of the anterior and middle thirds of the body, while in both *A. muhlingi* and *A. crami* it is situated at the equator.
4. In *A. eccentricus* the vitellaria never extend beyond the ovary anteriorly, while in *A. muhlingi* the vitellaria extend anteriorly as far as the acetabulum and in *A. crami* they extend anteriorly to a point about midway between the acetabulum and the ovary.
5. The eggs of *A. eccentricus* measure about 0.022 by 0.012 mm, while they measure about 0.032 by 0.018 mm in *A. muhlingi* and 0.033 by 0.025 mm in *A. crami*.

SUMMARY

Two new species of Heterophyidæ Odhner, 1914; namely, *Apophallus eccentricus* and *Monorchotrema calderoni*, are described from the small intestine of Philippine dogs.

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ILLUSTRATION

PLATE 1

FIG. 1. *Monorchotrema calderoni* sp. nov.
2. *Apophallus eccentricus* sp. nov.

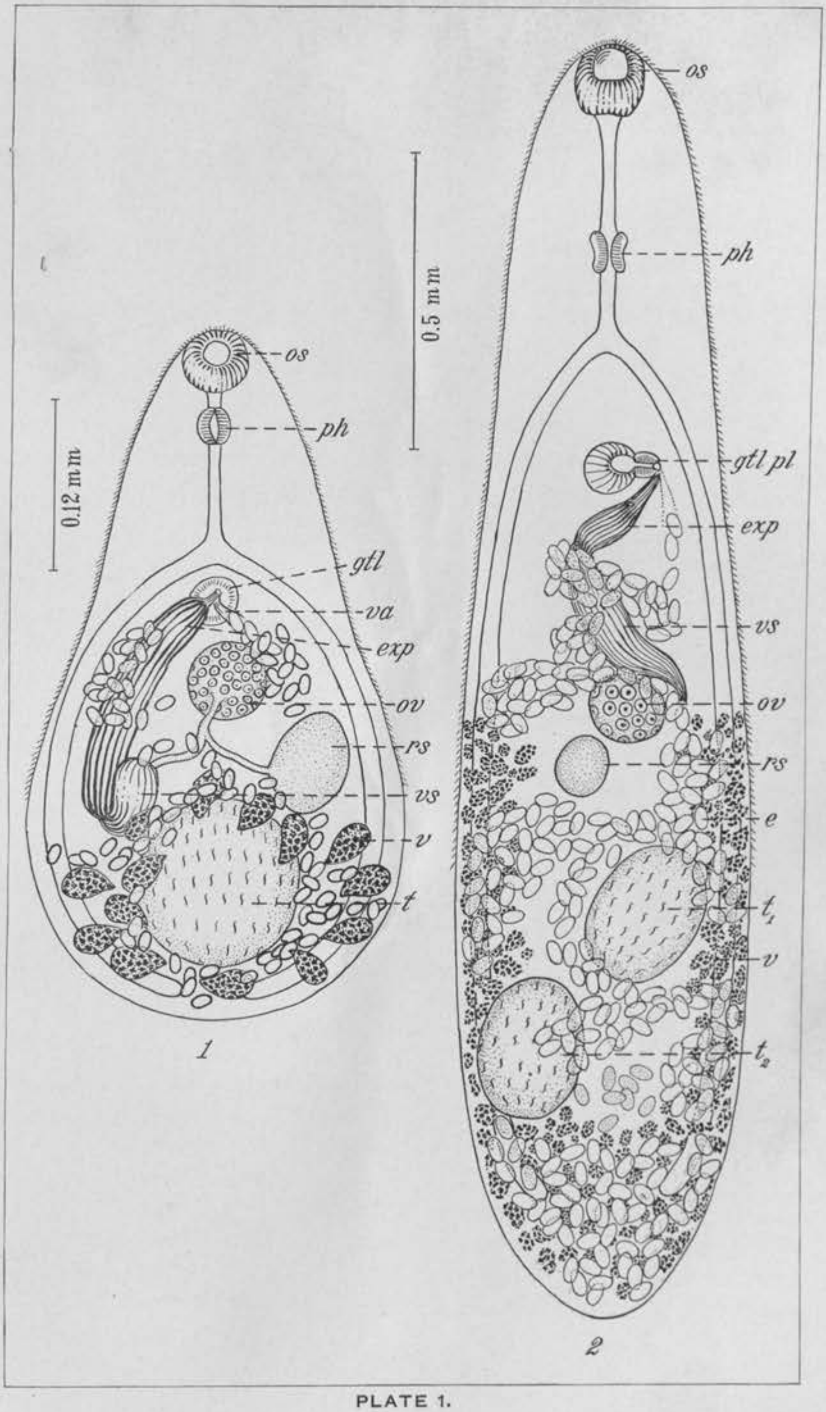
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PLATE 1.

DIPHYLLOBOTHRIUM LATUM (LINNÆUS, 1758) LÜHE, 1910, IN A NATIVE FILIPINO

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ONE PLATE

Garrison (1907), after making fæcal examinations of about 4,000 Bilibid prisoners, mentioned the probability of finding *Diphyllobothrium latum* in man and in domestic animals in the Philippines in the future. He based this opinion on the geographic relations of this country to China and Japan where this tapeworm is endemic, and on the important rôle that fish play in the diet of the Filipinos. Crowell and Hammack (1913) reported many helminths encountered in 500 human autopsies, but evidently they failed to find any diphyllobothrid. Wharton (1917), however, reported the occurrence of *Diphyllobothrium* sp. in the intestine of 5 per cent of 118 dogs autopsied in the City of Manila. Tubangui (1925) listed *Diphyllobothrium mansoni* Cobbold, 1882, among the tapeworms occurring in dogs and cats in this country; so the diphyllobothrid that Wharton reported from dogs probably belongs to this species. Schwartz and Tubangui (1922) also failed to detect *Diphyllobothrium* infestation in the fæces of 500 students of the University of the Philippines from nearly all provinces of the country, although they encountered several cyclophyllidean infestations; such as, *Tænia, Hymenolepis, Dipylidium,* etc. Since then various other similar surveys have been made, but *Diphyllobothrium* infestation was conspicuous by its absence. The recent discovery, therefore, of a *Diphyllobothrium* infestation in a Filipino child who has never been out of the Islands, which appears to involve the well-known *Diphyllobothrium latum,* excited no little interest, as it tends to define a new area in the geographic distribution of this important tapeworm, and suggests the possibility of its recent introduction from foreign endemic areas.

CASE REPORT

F. B., a 7-year-old Filipino boy, born and residing in Biñang, Laguna Province, Luzon, complained of marked pallor, slight puffiness of the eyelids, and slight œdema of the lower extremities. Illness about five months in duration, according to the mother. First noticed as slight pallor of the lips and cheeks, the anæmia developing progressively until the child began to have in the course of three months after the onset, frequent attacks of palpitation, chest oppression accompanied by nausea and slight dizziness. Later the child developed bleeding gums, and œdema of the extremities and occasional epistaxis. Treated by various physicians as a case of chronic nephritis. Eventually came to the senior author and the case was treated as one of severe anæmia, secondary to hookworm disease with the following physical findings: Marked pallor, puffy eyelids, slightly œdematous lower extremities, swollen and congested gums, dyspneic breathing, sibilant râles over both bases of lungs, enlarged area of cardiac dullness and soft systolic murmur over the pulmonic area, which is transmitted to the mitral area; abdomen slightly bulging without evidence of fluid. Condition rapidly developed from bad to worse, and the child died about five months after the onset of illness. Immediately after death several chains of segments of what appeared to be a diphyllobothrid tapeworm were recovered by the mother and presented to the senior author. It was not till after this happening that it dawned upon the mind of the senior author that he had been dealing with a case of *Diphyllobothrium* infestation, and fully realized his misdiagnosis of a typical case of *Diphyllobothrium latum* anæmia due to the deep-rooted conviction that such infestation was absent in the Philippines.

DESCRIPTION OF THE WORM

The mature segments in fresh state average 1.5 mm long by 9.5 mm broad; while the gravid segments average 1.8 mm long by 10 mm broad. The testes are small, multiple, spherical bodies situated in the lateral fields near the dorsal surface of the segment. They are drained by several vasa efferentia which converge towards the median line to form one common duct, the ductus deferens. This duct proceeds anteriad as a convoluted tubule and ends in a muscular cirral organ, which opens on the anterior aspect of the common genital pore. The ovary is a somewhat symmetrical bilobed structure situated near

the ventral surface in the posterior fourth of the segment. In the median line between these two lobes is the shell-gland complex, which is connected at its anterior aspect with the common duct formed by the union of the two oviducts and posterior end of the vagina. From this union the vagina proceeds anteriad describing two or three coils and opening on the posterior aspect of the common genital pore. In the lateral fields ventral to the testes are the vitelline glands, the ducts of which converge to form the right and left main ducts, which in turn fuse into a common vitelline duct. The uterus arises from the left anterior aspect of the oötype, twists back and forth from side to side, and finally terminates in a uterine pore situated in the median line a short distance posterior to the common genital pore. The number of coils on each side varies from three to five depending on the number of eggs to be accommodated. These coils are disposed in a rosette formation in gravid segments. The eggs are operculated, have the characteristic somewhat rounded abopercular end, and measure 0.069 mm by 0.045 mm.

Judging from the foregoing description of this diphyllobothrid and the characteristic symptoms of *Diphyllobothrium* anæmia with which it has been associated, it is evident that we are dealing with an infestation of *Diphyllobothrium latum.*

DISCUSSION

The fact that *Diphyllobothrium latum* has not been encountered previously among native Filipinos despite years of active helminthologic surveys and thousands of autopsies performed both in Manila and other regions of the Archipelago, suggests either (*a*) that it is of recent introduction from some foreign endemic focus, or (*b*) that it has long been endemic in this country, but occurs in such a small percentage of the population that it has remained undetected until the present time. That the habit of eating raw fish is not popular among Filipinos can hardly be offered as a reason for its rare occurrence here, since recently the present authors (Africa and Garcia, 1935) discovered several heterophyids—such as, *Monorchotrema taichui, Monorchotrema taihokui, Diorchitrema pseudocirrata,* and a hitherto undescribed species of the genus *Heterophyes*—among natives, infestations that are known to be contracted through eating various forms of raw fish. Furthermore, had this diphyllobothrid been endemic here for some time, autopsies of dogs and cats would have yielded this tapeworm in the past, as has

been the experience wherever this tapeworm is endemic. The first possibility, therefore, is held the more likely considering the following circumstancial evidence: (*a*) This infestation first appeared in this country in one of the towns located on the shore of Laguna de Bay, a fresh-water lake into which *Cyprinus carpio* of the Family Cyprinidæ, which includes the vertebrate intermediate hosts of this diphyllobothrid in China, was introduced successfully eight years ago from the latter country; (*b*) Chinese and Japanese immigrants have settled right along the shore of this lake, in fact the junior author has been witness to the fact that in one of the Japanese restaurants located in one of the towns bordering the lake, the closet is built right over the water line; (*c*) this lake is rich in *Cyclops* and *Diaptomus*, and considering that *Diphyllobothrium latum* lacks specificity in its choice of a crustacean intermediate host, it would seem that the recent introduction of *Cyprinus carpio* into this locality supplied what had been long missing in the past for the successful introduction of this tapeworm into this region. Otherwise, this diphyllobothrid would have appeared a long time ago in the Philippines, since Chinese and Japanese have been coming to this country from time immemorial.

This is not the first instance wherein the spread of this infestation to a new area has been noted. There is also ample evidence, although direct proofs are lacking, that *D. latum*, which is found frequently infesting the inhabitants of the states bordering the Great Lakes of North America, was taken to that new area by immigrants from countries bordering the Baltic Sea.

That diphyllobothrids lack specificity in their choice of crustacean intermediate hosts is shown by the experience of Li (1929) with *Diphyllobothrium decipiens* and *D. erinacei* whose procercoid can develop in almost any species of *Cyclops*. In the Philippines Africa (1933) successfully infected *Cyclops serrulatus* Fischer and *C. bicolor* Sars with coracidia of *Diphyllobothrium mansoni*. The researches of Janicki and Rosen (1917) and Essex (1927) (cited by Faust et al., 1929) have incriminated *Cyclops strenuus*, *C. brevispinosus*, *C. prasinus*, *Diaptomus gracilis*, and *D. oregonensis* as first intermediate hosts of *Diphyllobothrium latum*. As the Philippines is very rich in fresh-water crustaceans, there seems to be no reason why *D. latum* cannot gain a permanent foothold in this country provided the right species of fish are present. Again, in this respect *D. latum* exhibits a remarkable range in its choice of a piscine host. In

Europe it is either the pike (*Esox lucius*), the perch (*Perca fluviatilis*), the miller's thumb (*Lota vulgaris*), the salmon (*Salmo umbla*), the trout (*Trutta vulgaris*), the lake trout (*T. locustris*), or the grayling (*Thymallus vulgaris*); in North America it is either the northern pike (*Esox lucius*), the wall eye (*Stizosctedium vitreum*), the sand pike (*S. canadense griseum*), or the turbot (*Lota maculosa*); in Japan it is the rainbow trout (*Onchorhynchus perryi*); in China it is *Barbus vulgaris* or other members of the Family Cyprinidæ.

According to Herre (1928) the carp planted in Laguna de Bay showed a surprising growth, increasing rapidly in length and breadth and maturing sexually in ten months. Because of this development and the frequent catches of this fish by the people around the lake, he is of the opinion that it will never become extinct in its new home. If our surmise that it has been responsible for the introduction of *Diphyllobothrium latum* into this locality is correct, it would seem that a new endemic focus of this infestation has been established in the Philippines. We predict that more cases will appear among the inhabitants of the lake region, and that autopsies of dogs and cats of this area will yield more specimens of this tapeworm. This would mean a new parasitic disease of clinical and public-health importance in this country.

SUMMARY AND CONCLUSION

A diphyllobothrid tapeworm answering the description of *Diphyllobothrium latum* (Linnæus, 1758) Lühe, 1910, has been recovered from a native Filipino child, who died with clinical symptoms of pernicious anæmia. The authors believe that this cestode has been recently introduced into the Philippines from a foreign endemic focus, probably either China or Japan. They base their belief on the following grounds: (*a*) This infestation has never been encountered hitherto in native Filipinos, despite years of active helminthologic surveys and thousands of autopsies both in Manila and other parts of the country; (*b*) the infestation has been detected in a town located right on the shore of Laguna de Bay precisely where *Cyprinus carpio*, a species of fish belonging to the barbus group (which includes the secondary intermediate hosts of this diphyllobothrid in China) was introduced successfully from the latter country eight years ago; (*c*) extensive autopsies of cats and dogs, for many years, have failed to detect this infestation among these animals, which

would not have been the case had this diphyllobothrid long been endemic in the country. The authors predict that more cases of this infestation will appear among the inhabitants of this area, and that this tapeworm, if searched for, will also be found in cats and dogs of the same locality. This means a new parasitic disease of clinical and public-health interests in the Philippines.

ACKNOWLEDGMENT

We are indebted to Mr. Agustin Umali, of the Fish and Game Administration, Bureau of Science, for giving us information about the carp in the Philippine lakes.

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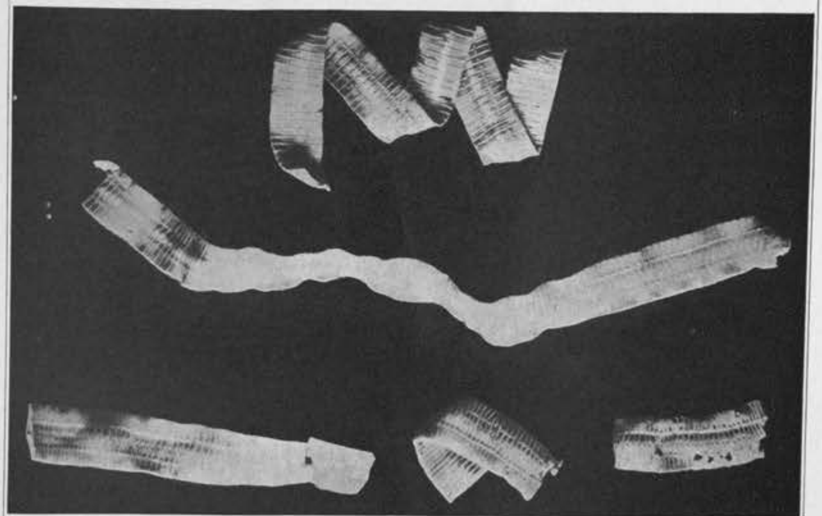
ILLUSTRATION

PLATE 1. DIPHYLLOBOTHRIUM LATUM (LINNÆUS, 1758) LÜHE, 1910

FIG. 1. Fragmented strobila of the worm; preserved in 5 per cent formalin.

2. An egg, × 638.

3. A mature segment; *cgp*, common genital pore; *ov*, ovary; *t*, testis; *va*, vagina; *vg*, vitelline glands; *utc*, uterine coils; *utp*, uterine pore.



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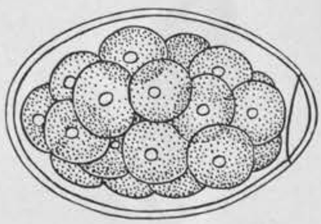

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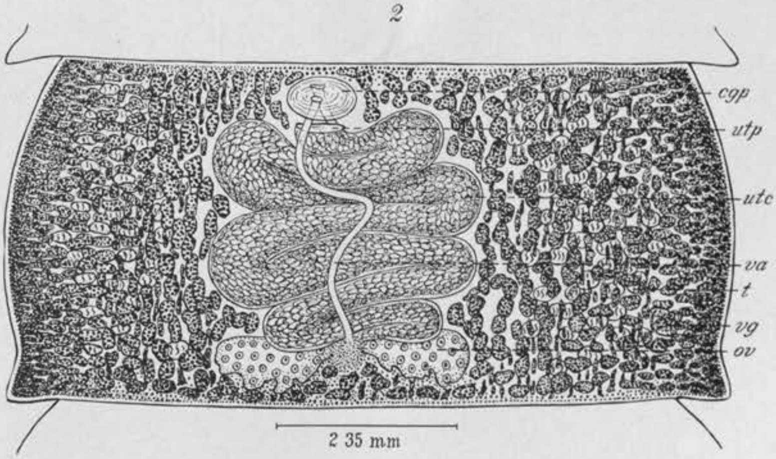

3

PLATE 1.

TERATOLOGY OF PHILIPPINE ORCHIDS, II

By EDUARDO QUISUMBING

Curator, Philippine National Herbarium, Bureau of Science, Manila

ONE PLATE

This is a continuation of my studies on the teratology of Philippine orchids.[1] From time to time orchid enthusiasts of Manila have furnished me with materials for this paper. All flowers reported in this paper are preserved in liquid and deposited in the Philippine National Herbarium.

PAPHIOPEDILUM ARGUS (Reichb. f.) Stein. Plate 1, fig. 13.

This is a very common ground orchid in the Philippines. All the floral organs are normal and typical of the species except one of the petals with a pouchlike concave apex. The specimen was collected from a plant belonging to Mrs. K. B. Day, March, 1935.

DENDROBIUM ANOSMUM Lindl. Plate 1, fig. 17.

The figure was prepared under the direction of former Director Merrill of the Bureau of Science, at present director-in-chief of the New York Botanical Garden. The flower on the left is typical of the species. The double flower had only five sepals, the sixth one being diverted into a lip. There are three lips, the basal one being largest. The petals are normally four. The column is much enlarged with three anther caps. Collected by Mr. W. S. Lyon, Manila, March 26, 1919.

PHALAENOPSIS EQUESTRIS (Schauer) Reichb. f.

Cases of winged columns were reported in *Phalaenopsis aphrodite* and *P. schilleriana* but none from this species. The following have been observed:

Case 1.—The dorsal sepal and petals are normal. The two lateral sepals are absent. The front lobe of the lip approaches in size a typical form, with the exception of a small appendage at the margin and on the surface. One lateral lobe of the lip is present, and this slightly longer than the normal one. The

[1] Orch. Rev. 39 (1931) 131, *fig. 1;* Philip. Journ. Sci. 49 (1932) 137–139, *3 pls.*

specimen was collected from a plant owned by Mrs. Remedios C. Gonzalez, December 19, 1932; figs. 6 and 7.

Case 2.—This is one of the most interesting teratological cases in this species. The "Siamese Twins" has two normal flowers, joined back to back with one common pedicellate ovary. The "twins" were kindly supplied the author by Mrs. Helen Leas Cothran, March 27, 1935; figs. 10 to 12.

Case 3.—All the floral organs are complete and normal with the exception of the column which is capped with a prominent hood. The column is provided with a very thin, membranaceous, winged appendage, attached on both sides of the column. The specimen was collected from a plant owned by Mrs. K. B. Day, January 31, 1935; figs. 8 and 9.

Case 4.—All floral organs are typical of the species except the two petals which were decidedly abnormal. Except the width, the more intense coloration and the absence of the lateral lobes, these petals approximated to the labellum. At the base of each petal is a sharp, thin appendage which looks like a rudimentary callus. The flowers on the peduncles were much more handsome than the normal flowers. The leaves are typical of *P. equestris.* The specimen was kindly supplied the author by Mr. Emilio Ermitaño, August 7, 1933; fig. 16.

PHALAENOPSIS SANDERIANA Reichb. f.

This is one of the most unusual freaks ever met in the genus *Phalaenopsis.* The color and texture of the floral parts suggest very close resemblance to a typical *Phalaenopsis sanderiana,* but the habit of the plant and the color and texture of the leaves are typically of *Phalaenopsis lueddemanniana.* The leaves are oblanceolate, fleshy, green on both surfaces, about 21 cm long, 8.7 cm wide. The inflorescence is about 20 cm long with 9 to 11 flowers. The flower (fig. 18) when fully opened is 5.7 to 6 cm across. The dorsal sepal is oblong, about 3.5 cm long and 1.8 cm wide. The lateral sepals are slightly oblique lanceolate, about 3.3 cm long, 1.5 cm wide. The true lip is entirely absent, and in its place is a structure similar in shape and texture to the petals, about 3.4 cm long, 1.5 cm wide. The column (figs. 14 and 15) is short and stout with three appendages on top. The anther is absent. The plant was collected by District Engineer A. Aquino from the forests between Cebu and Toledo, Cebu Island, and the specimen under description was brought to Manila by Mr. Aquino April 2, 1935. Accord-

ing to Mr. Aquino, the plant has flowered twice during this year, and in both flowerings, all flowers were of this nature.

SPATHOGLOTTIS PLICATA Blume. Plate 1, fig. 5.

Costerus and Smith[2] reported a case in this species showing transformation of petals into labella. In my first paper (l. c.), I mentioned a case in which the dorsal sepal was intimately united with the right petal. In this particular case the dorsal sepal is confluent with the petal halfway from the base only.

GRAMMATOPHYLLUM SCRIPTUM (Linn.) Blume. Plate 1, fig. 2.

These abnormal flowers are usually found at the base of the peduncles, charaterized by the suppression of organs. The dorsal sepal and petals are both normal in size and color. The lateral sepals are confluent, the joined structures are slightly larger than the dorsal sepal. The labellum is completely absent and in its place are the confluent lateral sepals. The column is much smaller than the normal one, otherwise it is complete in its parts. The specimen was collected in Mrs. Applegate's gardens at Santa Mesa, Manila, June 15, 1934.

GRAMMATOPHYLLUM SPECIOSUM Blume.

The flower (fig. 1) has normal dorsal sepal and petals. The lateral sepals are confluent. The labellum is absent and in its place are the confluent lateral sepals. The column is a much reduced structure. The specimen was collected among the plants in the orchid house of Mrs. Remedios C. Gonzales, Manila, February, 1934.

Figures 3 and 4 were from a much reduced flower. The flower has only two floral segments and the column was very much reduced. From the collections of Mrs. Remedios C. Gonzales.

[2] Ann. Jard. Bot. Buitenzorg 28 (1914) 133.

ILLUSTRATION

PLATE 1

FIG. 1. *Grammatophyllum speciosum* Blume, front view of flower, × 0.33.
2. *Grammatophyllum scriptum* (Linn.) Blume, front view of flower, × 0.33.
3. *Grammatophyllum speciosum* Blume, front view of flower, × 0.33.
4. *Grammatophyllum speciosum* Blume, side view of flower, × 0.33.
5. *Spathoglottis plicata* Blume, front view of flower, × 0.66.
6. *Phalaenopsis equestris* (Schauer) Reichb. f., front view of flower, × 0.66.
7. *Phalaenopsis equestris* (Schauer) Reichb. f., labellum from above, × 1.33.
8. *Phalaenopsis equestris* (Schauer) Reichb. f., front view of colmun, × 1.33.
9. *Phalaenopsis equestris* (Schauer) Reichb. f., side view of column, × 1.33.

FIGS. 10 to 12. *Phalaenopsis equestris* (Schauer) Reichb. f., different views of "Siamese Twins," × 0.66.

FIG. 13. *Paphiopedilum argus* (Reichb. f.) Stein, front view of flower, × 0.33.
14. *Phalaenopsis sanderiana* Reichb. f., front view of column, × 1.33.
15. *Phalaenopsis sanderiana* Reichb. f., side view of column, × 1.33.
16. *Phalaenopsis equestris* (Schauer) Reichb. f., front view of flower, × 0.66.
17. *Dendrobium anosmum* Lindl., normal and double flowers, × 0.33.
18. *Phalaenopsis sanderiana* Reichb. f., front view of flower, × 0.33.

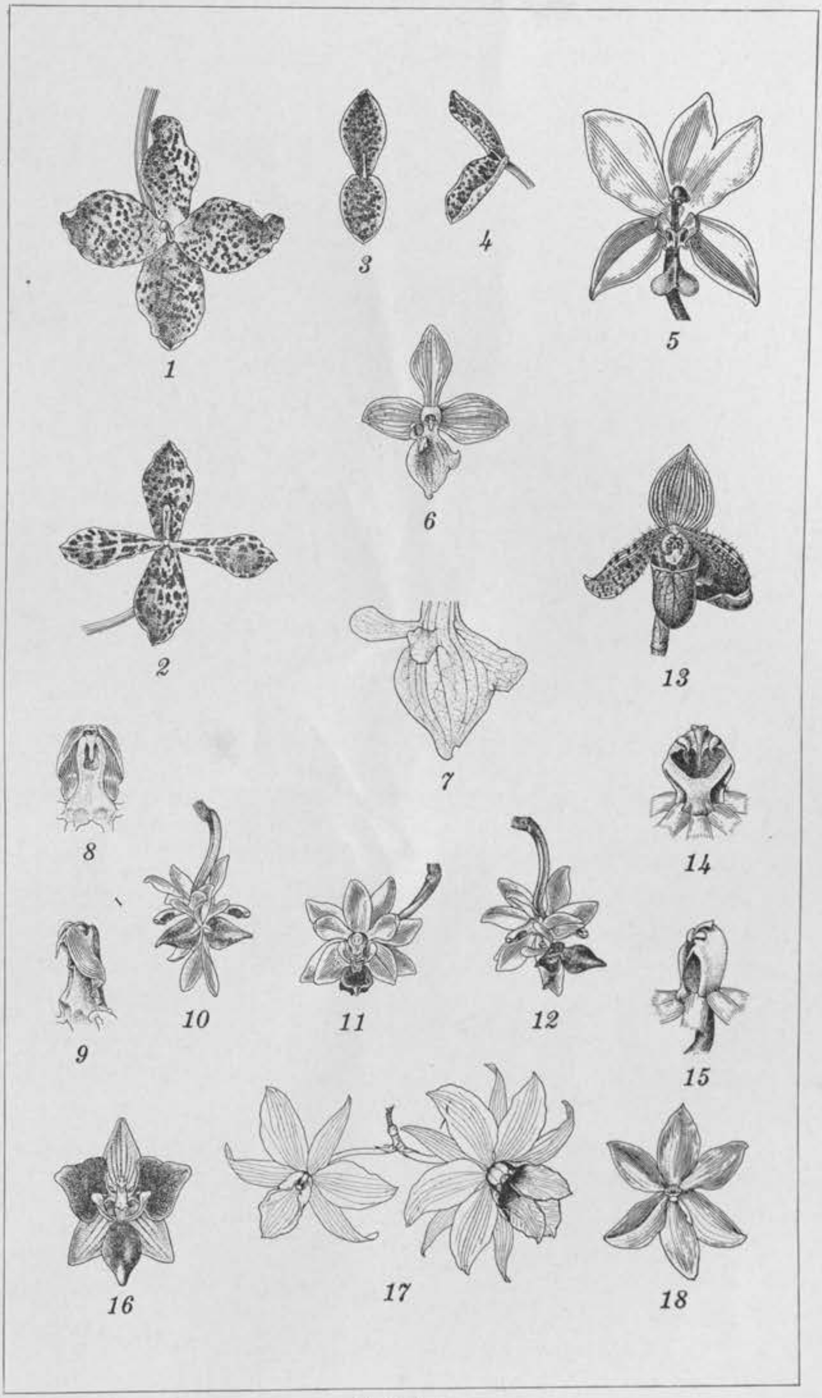

PLATE 1.

DIATOMS FROM POYANG LAKE, HUNAN, CHINA

By B. W. SKVORTZOW

Of Harbin, Manchoukuo

THREE PLATES

The diatoms described in the following paper were collected in October, 1929, by the Rev. Umberto Verdini in the Eastern Lake of the City of Poyang, Hunan, China, on lotus leaves. This collection was received through the kindness of Mr. A. Beltchenko, of Hankow. The collection from Poyang contained eighty-four species and varieties of diatoms, among which were found eleven new forms. They are as follows:

Synedra rumpens var. *sinica*.
Neidium hitchcockii var. *oblique-striatum*.
Navicula exigua var. *sinica*.
Navicula lambda Cleve var. *sinica*.
Navicula menisculus var. *sinica*.
Pinnularia interrupta var. *sinica*.
Pinnularia subsolaris var. *interrupta*.
Pinnularia subcapitata var. *sinica*.
Gomphonema acuminatum var. *sinica*.
Nitzschia bremensis var. *sinica*.
Nitzschia palea var. *gracilis*.

The diatoms of Poyang Lake have never been listed and so may be of interest. The species found in this collection are here enumerated.

CYCLOTELLA MENEGHINIANA Kutz. Plate 1, fig. 1.

Cyclotella meneghiniana F. HUSTEDT, Bacillar. (1930) 100, fig. 67.

Frustule, 0.01 mm in diameter. Costæ 8 in 0.01 mm. Central areas hyaline. A common fresh-water diatom.

CYCLOTELLA MENEGHINIANA Kutz. var. **TENERA** Kolbe. Plate 1, fig. 2.

Cyclotella meneghiniana Kutz. var. *tenera* KOLBE, Zur Okologie, Morph. u. System. d. Brackwasser Diatom. (1927) 33, pl. 1, figs. 17, 18.

Frustule, 0.015 mm in diameter. Costæ robust, 8 in 0.01 mm. Central areas with isolated puncta. Known from Europe.

CYCLOTELLA STELLIGERA Cleve and Grunow. Plate 1, fig. 3.

Cyclotella stelligera F. HUSTEDT, Bacillar. (1930) 100, fig. 65.

Frustule, 0.007 to 0.013 mm in diameter. Costæ 12 to 15 in 0.01 mm. Central areas with stellate ornamentation. A fresh-water species.

MELOSIRA GRANULATA (Ehr.) Ralfs. Plate 1, fig. 4.

Melosira granulata F. HUSTEDT, Bacillar. (1930) 87, fig. 44.

Frustule, 0.005 to 0.01 mm broad. Striæ punctate, 7 to 12 in 0.01 mm.

MELOSIRA GRANULATA (Ehr.) Ralfs forma CURVATA Grun. Plate 1, fig. 5.

Melosira granulata (Ehr.) Ralfs forma *curvata* F. HUSTEDT, Bacillar. (1930) 88.

Frustule curved, 0.0042 mm broad. Striæ punctate, 18 to 20 in 0.01 mm.

MELOSIRA GRANULATA (Ehr.) Ralfs var. ANGUSTISSIMA O. Mull. Plate 1, fig. 6.

Melosira granulata (Ehr.) Ralfs var. *angustissima* F. HUSTEDT, Bacillar. (1930) 88, fig. 45.

Frustule very narrow, 0.003 to 0.004 mm broad. Very common in fresh water.

MELOSIRA DISTANA (Ehr.) Kutz. Plate 1, fig. 7.

Melosira distana (Ehr.) F. HUSTEDT, Bacillar. (1930) 92, 93, fig. 53.

Frustule cylindrical, 0.005 mm broad. Striæ punctate, 15 in 0.01 mm. Common in fresh water.

FRAGILARIA CAPUCINA Desm. Plate 1, fig. 8.

Fragilaria capucina F. HUSTEDT, Bacillar. (1930) 138, fig. 26.

Valve linear-lanceolate with truncate rounded ends. Length, 0.024 mm; breadth, 0.0025; striæ 11 in 0.01 mm. A well-known fresh-water species.

SYNEDRA VAUCHERIAE Kutz. var. TRUNCATA (Greville) Grun. Plate 1, fig. 9.

Synedra vaucheriae Kutz. var. *truncata* (Greville) F. HUSTEDT, Bacillar. (1930) 161, fig. 193.

Valve linear-lanceolate with obtuse ends. Length, 0.017 mm; breadth, 0.004. A fresh-water species.

SYNEDRA ULNA (Nitzsch.) Ehr. Plate 1, fig. 10.

Synedra ulna (Nitzsch.) F. HUSTEDT, Bacillar. (1930) 151, 152, fig. 159*b*.

Valve linear-lanceolate, rostrate. Length, 0.03 mm; breadth, 0.006; striæ 9 in 0.01 mm. Common in fresh water.

SYNEDRA ULNA (Nitzsch.) Ehr. var. BICEPS Kutz. Plate 1, fig. 11.

Synedra ulna (Nitzsch.) Ehr. var. *biceps* F. HUSTEDT, Bacillar. (1930) 154, fig. 166*a*, *b*.

Valve with capitate ends. Length, 0.25 mm; breadth, 0.006; striæ 6 in 0.01 mm.

SYNEDRA PULCHELLA Kutz. var. LANCEOLATA O. Meara. Plate 1, fig. 12.

Synedra pulchella Kutz. var. *lanceolata* F. HUSTEDT, Bacillar. (1930) 160, fig. 187.

Valve very small, with truncate ends. Length, 0.02 mm; breadth, 0.0045; striæ 9 in 0.01 mm.

SYNEDRA RUMPENS Kutz. var. SCOTICA Grun. Plate 1, fig. 14.

Synedra rumpens Kutz. var. *scotica* F. HUSTEDT, Bacillar. (1930) 156, fig. 177.

Valve lanceolate with attenuate end. Length, 0.035 mm; breadth, 0.025; striæ 18 in 0.01 mm.

SYNEDRA RUMPENS Kutz. var. SINICA var. nov. Plate 1, fig. 13.

Valve lanceolate with rounded ends. Length, 0.095 mm; breadth, 0.005; striæ 11 to 12 in 0.01 mm. Differs from the type in its larger size.

EUNOTIA LUNARIS (Ehr.) Grun. Plate 1, fig. 15.

Eunotia lunaris F. HUSTEDT, Bacillar. (1930) 183, 184, fig. 249.

Valve linear, lunate, with rounded ends. Length, 0.096 mm; breadth, 0.0034; striæ 12 in 0.01 mm. A fresh-water species.

ACHNANTHES HUNGARICA Grun. Plate 1, figs. 16 to 19.

Achnanthes hungarica F. HUSTEDT, Bacillar. (1930) 201, fig. 283.

Valve linear-lanceolate, parallel in the middle part with cuneate and rounded ends. Length, 0.013 to 0.034 mm; breadth, 0.006 to 0.007; striæ 18 to 24 in 0.01 mm. A fresh-water species.

COCCONEIS PLACENTULA (Ehr.) var. EUGLYPTA (Ehr.) Cleve. Plate 1, fig. 20.

Cocconeis placentula (Ehr.) var. *euglypta* F. HUSTEDT, Bacillar. (1930) 190, fig. 261.

Valve elliptical. Length, 0.015 mm; breadth, 0.01. Common in fresh water.

NEIDIUM AFFINE (Ehr.) Cleve var. AMPHIRHYNCHUS (Ehr.) Cleve. Plate 1, fig. 21.

Neidium affine (Ehr.) Cleve var. *amphirhynchus* F. HUSTEDT, Bacillar. (1930) 243, fig. 377.

Valve linear, slightly gibbous in the middle with truncate, rounded ends. Length, 0.045 mm; breadth, 0.011; striæ 30 in 0.01 mm. A fresh-water species.

NEIDIUM HITCHCOCKII Ehr. var. **OBLIQUE-STRIATUM** var. nov. Plate 1, fig. 22.

Valve triundulate with rostrate ends. Length, 0.059 mm; breadth, 0.001; striæ oblique, 16 to 18 in 0.01 mm. Differs from the type by its oblique striæ.

NEIDIUM PRODUCTUM (W. Smith) Cleve. Plate 1, fig. 23.

Neidium productum F. HUSTEDT, Bacillar. (1930) 245, fig. 383.

Valve broad lanceolate with rostrate ends. Length, 0.064 mm; breadth, 0.018; striæ 18 to 20 in 0.01 mm. A fresh-water diatom.

CALONEIS BACILLUM (Grun.) Meresch. Plate 1, fig. 24.

Caloneis bacillum F. HUSTEDT, Bacillar. (1930) 236, fig. 360*a*.

Valve linear with parallel margins and rounded ends. Length, 0.025 mm; breadth, 0.006; striæ slightly radiate, 24 in 0.01 mm. Central areas a broad transverse fascia.

CALONEIS BACILLUM (Grun.) Meresch. var. **TRUNCULATA** Grun. forma. Plate 1, fig. 25.

Valve slightly gibbous on the middle. Length, 0.03 mm; breadth, 0.0052; striæ 21 in 0.01 mm, bilaterally interrupted. A fresh- and brackish-water species.

CALONEIS CLEVEI (Lagerst.) Cleve. Plate 1, fig. 26.

Caloneis clevei F. HUSTEDT, Bacillar. (1930) 236, fig. 359.

Valve lanceolate, slightly undulate with broad rounded ends. Length, 0.042 mm; breadth, 0.007; striæ slightly radiate, 18 in 0.01 mm. Axial areas narrow, dilated in the middle to a transverse fascia. A fresh-water species, known from Europe.

CALONEIS SILICULA (Ehr.) Cleve var. **GIBBERULA** (Kutz.) Grun. Plate 1, fig. 27.

Caloneis silicula (Ehr.) Cleve var. *gibberula* F. HUSTEDT, Bacillar. (1930) 238, fig. 365.

Valve slightly triundulate with rounded ends. Length, 0.056 mm; breadth, 0.01; striæ radiate, 18 in 0.01 mm. Axial areas somewhat dilated in the middle part. A fresh- and brackish-water species.

GYROSIGMA ACUMINATUM (Kutz.) Rabh. Plate 2, fig. 1.

Gyrosigma acuminatum F. HUSTEDT, Bacillar. (1930) 223, fig. 329.

Valve sigmoid with attenuate ends. Length, 0.091 mm; breadth, 0.013; striæ longitudinal and transversal, 18 in 0.01 mm. Common in fresh water.

STAURONEIS PHOENICENTERON Ehr.

Stauroneis phoenicenteron F. HUSTEDT, Bacillar. (1930) 255, fig. 404.

Valve lanceolate, attenuate. Length, 0.178 mm; breadth, 0.04.

STAURONEIS ANCEPS Ehr. forma **GRACILIS** (Ehr.) Cleve. Plate 2, fig. 2.

Stauroneis anceps Ehr. forma *gracilis* F. HUSTEDT, Bacillar. (1930) 256, fig. 406.

Valve robust with capitate ends. Length, 0.107 mm; breadth, 0.025. Common in fresh water.

NAVICULA HUNGARICA Grun. var. **CAPITATA** (Ehr.) Cleve. Plate 1, fig. 28.

Navicula hungarica Grun. var. *capitata* F. HUSTEDT, Bacillar. (1930) 298, fig. 508.

Valve lanceolate, gibbous in the middle, rostrate at the ends. Length, 0.021 mm; breadth, 0.0076; striæ robust, radiate, 7 in 0.01 mm. Common in fresh water.

NAVICULA EXIGUA (Greg.) O. Mull. var. **SINICA** var. nov. Plate 1, fig. 29.

Valve lanceolate with broad rounded margins and short rostrate ends. Axial areas narrow, somewhat dilated in the middle. Striæ radiate in the middle part, shortened, 17 to 18 in 0.01 mm. Length, 0.018 mm; breadth, 0.0068. This new variety differs from the type in its smaller size and its finer striæ.

NAVICULA PUPULA Kutz. Plate 1, figs. 30, 31.

Navicula pupula F. HUSTEDT, Bacillar. (1930) 281, fig. 467*a*.

Valve lanceolate with truncate ends. Striæ radiate, 24 in 0.01 mm. Axial areas dilated in the middle. Length, 0.018 to 0.024 mm; breadth, 0.007. A common fresh-water species.

NAVICULA PUPULA Kutz. var. **CAPITATA** Hust. Plate 1, fig. 32.

Navicula pupula Kutz. var. *capitata* F. HUSTEDT, Bacillar. (1930) 281, fig. 467*c*.

Valve linear-lanceolate with capitate ends. Median line narrow. Central areas a broad stauros, widened and truncate outwards. Striæ radiate, 24 in 0.01 mm. Length, 0.039 mm; breadth, 0.0085.

NAVICULA PUPULA Kutz. var. **ROSTRATA** Hust. Plate 1, fig. 33.

Navicula pupula Kutz. var. *rostrata* F. HUSTEDT, Bacillar. (1930) 282, fig. 467*e*.

Valve lanceolate with rounded ends. Length, 0.015 mm; breadth, 0.0068; striæ 25 in 0.01 mm.

NAVICULA LAMBDA Cleve var. **SINICA** var. nov. Plate 1, fig. 34.

Valve linear, not constricted, rectangular with broad ends. Striæ nearly parallel, 21 to 24 in 0.01 mm. Median line narrow. Length, 0.023 mm; breadth, 0.007. Differs from the type by its small size. *Navicula lambda* is known from Demerara River, Brazil.

NAVICULA AMERICANA Ehr. Plate 1, fig. 35.

Navicula americana F. HUSTEDT, Bacillar. (1930) 280, fig. 464.

Valve rectangular with broad ends. Axial areas narrow. Median line in a thick siliceous rib. Striæ subradiate, 18 in 0.01 mm. Length, 0.037 mm; breadth, 0.013. Not common.

NAVICULA CUSPIDATA Kutz. Plate 2, fig. 3.

Navicula cuspidata F. HUSTEDT, Bacillar. (1930) 268, fig. 433.

Valve lanceolate with attenuated ends. Transverse striæ 12 in 0.01 mm; longitudinal striæ 30 in 0.01 mm. Length, 0.102 mm; breadth, 0.024. Not common.

NAVICULA CRYPTOCEPHALA Kutz. Plate 1, fig. 36.

Navicula cryptocephala F. HUSTEDT, Bacillar. (1930) 295, fig. 496.

Valve lanceolate with attenuated ends. Striæ radiate, divergent in the middle, 15 in 0.01 mm. Axial areas narrow. Length, 0.032 mm; breadth, 0.007. A fresh- and brackish-water species.

NAVICULA CRYPTOCEPHALA Kutz. var. EXILIS (Kutz.) Grun. Plate 1, fig. 37.

Navicula cryptocephala Kutz. var. *exilis* F. HUSTEDT, Bacillar. (1930) 295.

Valve lanceolate with short ends. Striæ radiate, 20 in 0.01 mm. Length, 0.024 mm; breadth, 0.0068.

NAVICULA MENISCULUS Schumann var. SINICA var. nov. Plate 1, fig. 38.

Valve broad-lanceolate, gibbous in the middle. Striæ 10 in 0.01 mm; divergent and shortened in the middle. Axial areas narrow, central areas slightly tranversely dilated. Length, 0.037 mm; breadth, 0.009. This new variety differs from the type in its size. Also found at Yentsche, Chansi.

PINNULARIA PLATYCEPHALA (Ehr.) Cleve forma. Plate 2, fig. 14.

Valve broad-linear, with large capitate ends. Striæ divergent in the middle, convergent at the ends, 9 in 0.01 mm. Length, 0.072 mm; breadth, 0.015.

PINNULARIA PLATYCEPHALA Cleve var. HATTORIANA Meister. Plate 2, fig. 4.

Pinnularia platycephala Cleve var. *hattoriana* MEISTER, Beiträge z. Bacillar. Japans. 2 (1914) 228, pl. 8, figs. 6, 7.

Valve linear, triundulate, slightly attenuate, with rounded ends. Striæ 12 in 0.01 mm, divergent at the ends. Central areas a broad transverse fascia. Median line straight, terminal fissures bayonet-shaped. Length, 0.078 mm; breadth, 0.013. Known from Nippon only.

PINNULARIA SUBCAPITATA Greg. var. PAUCISTRIATA Grun. Plate 2, fig. 5.

Pinnularia subcapitata Greg. var. *paucistriata* V. HEURCK, Synopsis (1880–81) pl. 6, fig. 23.

Valve linear-lanceolate with parallel margins. Axial areas somewhat dilated in the middle to a transverse fascia. Striæ radiate, 12 to 15 in 0.01 mm. Length, 0.017 to 0.02 mm; breadth, 0.006.

PINNULARIA SUBCAPITATA Greg. var. SINICA var. nov. Plate 2, fig. 6.

Valve lanceolate with truncate ends. Striæ 15 in 0.01 mm. Length, 0.017 mm; breadth, 0.0036. Differs from the type only in its size.

PINNULARIA INTERRUPTA W. Smith var. SINICA var. nov. Plate 2, fig. 7.

Valve lanceolate, constricted, with rostrate ends. Striæ almost parallel or slightly radiate, 9 to 10 in 0.01 mm. Central areas a broad transverse fascia. Length, 0.025 mm; breadth, 0.005. Differs from the type in its elongate ends. By its dimensions this form resembles forma *hankensis* Skvortz.

PINNULARIA SUBSOLARIS (Grun.) Cleve. Plate 2, fig. 8.

Pinnularia subsolaris F. HUSTEDT, Bacillar. (1930) 322, fig. 388.

Valve linear-lanceolate, slightly attenuate and rounded ends. Striæ slightly radiate, 10 in 0.01 mm. Median line somewhat dilated in the middle. Length, 0.047 mm; breadth, 0.01. A fresh-water diatom.

PINNULARIA SUBSOLARIS (Grun.) Cleve var. INTERRUPTA var. nov. Plate 2, fig. 9.

Valve lanceolate with rounded ends. Central areas a broad transverse fascia. Length, 0.047 mm; breadth, 0.009; striæ 9 in 0.01 mm.

PINNULARIA VIRIDIS (Nitzsch.) Ehr. Plate 2, fig. 10.

Pinnularia viridis A. SCHMIDT, Atlas Diatom. (1876) pl. 42, fig. 23.

Valve lanceolate, gibbous in the middle, attenuate at the ends. Striæ divergent in the middle, slightly convergent at the ends, 9 in 0.01 mm. Length, 0.06 mm; breadth, 0.014. Common in fresh water.

PINNULARIA GIBBA Ehr. Plate 2, fig. 11.

Pinnularia gibba F. HUSTEDT, Bacillar. (1930) 327, fig. 600*b*.

Valve linear, gibbous in the middle and attenuate at the ends. Striæ radiate, 11 in 0.01 mm, divergent in the middle, convergent at the ends. Central areas a broad fascia. Length, 0.054 mm; breadth, 0.0068. A fresh-water species.

PINNULARIA GIBBA Ehr. forma **SUBUNDULATA** Mayer. Plate 2, fig. 12.

Pinnularia gibba Ehr. forma *subundulata* F. HUSTEDT, Bacillar. (1930) 327, fig. 601.

Valve linear with subundulate margins. Length, 0.070 mm; breadth, 0.01; striæ 8 to 9 in 0.01 mm.

PINNULARIA BRAUNII (Grun.) Cleve var. **AMPHICEPHALA** (A. Mayer) Hust. Plate 2, fig. 13.

Pinnularia braunii (Grun.) Cleve var. *amphicephala* F. HUSTEDT, Bacillar. (1930) 319, fig. 578.

Valve linear with capitate ends. Median line a broad transverse fascia. Length, 0.035 mm; breadth, 0.0068; striæ radiate, 12 in 0.01 mm. An alpine species.

PINNULARIA DACTYLUS Ehr.

Valve linear-elliptic. Length, 0.14 mm; breadth, 0.013; striæ 6 in 0.01 mm.

AMPHORA VENETA (Kutz.). Plate 2, fig. 15.

Amphora veneta F. HUSTEDT, Bacillar. (1930) 345, fig. 631.

Valve lanceolate with gibbous dorsal margin. Length, 0.02 mm; breadth, 0.013; striæ 18 to 20 (middle) or 24 (ends) in 0.01 mm. A fresh- and brackish-water diatom.

AMPHORA OVALIS Kutz. Plate 2, fig. 16.

Amphora ovalis F. HUSTEDT, Bacillar. (1930) 342, fig. 628.

Valve gibbous. Length, 0.024 mm; breadth, 0.014; striæ without fascia, 15 in 0.01 mm. Common in fresh water.

AMPHORA OVALIS Kutz. var. **LIBYCA** (Ehr.) Cleve. Plate 2, fig. 17.

Amphora ovalis Kutz. var. *libyca* A. SCHMIDT, Atlas Diatom. (1875) pl. 26, fig. 105.

Valve asymmetrical with gibbous dorsal margins. Striæ radiate, 15 in 0.01 mm. In the middle opposite the stigma a broad fascia. Length, 0.024 mm; breadth, 0.015. A fresh-water species.

AMPHORA NORMANI Rabh. Plate 2, fig. 18.

Amphora normani F. HUSTEDT, Bacillar. (1930) 343, 344, fig. 630.

Valve lanceolate with oblique ends. Length, 0.015 mm; breadth, 0.0034. Common in mosses.

AMPHORA COFFEAEFORMIS Agardh var. Plate 2, fig. 19.

Valve lunate with attenuate ends. Length, 0.018 mm; breadth, 0.0034; striæ radiate, 15 in 0.01 mm. A brackish-water species.

CYMBELLA TUMIDA (Breb.) V. Heurck. Plate 2, figs. 20, 21.

Cymbella tumida F. HUSTEDT, Bacillar. (1930) 366, fig. 677.

Valve cymbiform with rostrate ends. Striæ divergent in the middle, convergent at the ends, 9 (dorsal) or 10 (ventral) in 0.01 mm. Length, 0.045 to 0.06 mm; breadth, 0.015 to 0.018. A fresh-water species.

CYMBELLA TUMIDA (Breb.) V. Heurck var. BOREALIS Grun. Plate 3, fig. 1.

Valve with elongate ends. Length, 0.092 mm; breadth, 0.022; striæ 7 to 8 in 0.01 mm.

CYMBELLA TURGIDA (Greg.) Cleve. Plate 3, fig. 2.

Cymbella turgida F. HUSTEDT, Bacillar. (1930) 358, fig. 660.

Valve cymbiform with attenuate ends. Length, 0.049 mm; breadth, 0.012; striæ 7 in 0.01 mm. A fresh-water species.

CYMBELLA VENTRICOSA Kutz. Plate 3, fig. 3.

Cymbella ventricosa F. HUSTEDT, Bacillar. (1930) 359, fig. 661.

Valve cymbiform. Length, 0.023 mm; breadth, 0.005; striæ 14 (dorsal) or 12 (ventral) in 0.01 mm.

GOMPHONEMA INTRICATUM Kutz. Plate 3, fig. 4.

Gomphonema intricatum F. HUSTEDT, Bacillar. (1930) 375, fig. 697.

Valve lanceolate, narrowed towards the ends. Length, 0.03 mm; breadth; 0.005; striæ 12 in 0.01 mm.

GOMPHONEMA PARVULUM (Kutz.) Grun. Plate 3, figs. 5, 6.

Gomphonema parvulum F. HUSTEDT, Bacillar. (1930) 372, fig. 713.

Valve with gibbous ends attenuated towards the rounded ends. Length, 0.017 mm; breadth, 0.005; striæ 15 in 0.01 mm.

GOMPHONEMA PARVULUM (Kutz.) Grun. var. LAGENULA (Kutz. Grun.) Hust. Plate 3, fig. 7.

Gomphonema parvulum (Kutz.) Grun. var. *lagenula* V. HEURCK, Synopsis (1880–81) pl. 25, fig. 7.

Valve gibbous in the middle with rostrate ends. Length, 0.025 mm; breadth, 0.007; striæ almost parallel, 15 in 0.01 mm.

GOMPHONEMA PARVULUM (Kutz.) Grun. var. SUBELLIPTICA Cleve. Plate 3, fig. 8.

Gomphonema parvulum (Kutz.) Grun. var. *subelliptica* F. HUSTEDT, Bacillar. (1930) 373, fig. 713*b*.

Valve minute with acute ends. Length, 0.012 mm; breadth, 0.0032; striæ 18 in 0.01 mm.

GOMPHONEMA ACUMINATUM Ehr. var. **TURRIS** (Ehr.) Cleve. Plate 3, fig. 9.

Gomphonema acuminatum Ehr. var. *turris* A. SCHMIDT, Atlas Diatom. (1902) pl. 239, figs. 33, 34.

Valve constricted, attenuate at the apex and elongate at the base. Length, 0.035 mm; breadth, 0.0068; striæ 12 to 15 in 0.01 mm.

GOMPHONEMA ACUMINATUM Ehr. var. **SINICA** var. nov. Plate 3, figs. 10, 11.

Valve clavate, broad, gibbous in the middle, slightly attenuate towards the apex and elongate towards the base. Striæ 9 to 10 in 0.01 mm, in the middle almost parallel, convergent at the apex. The median stria opposite the stigma shortened. Length, 0.039 to 0.051 mm; breadth, 0.012 to 0.013. This variety differs from var. *turris* in its broad margins.

GOMPHONEMA LANCEOLATUM Ehr. Plate 3, fig. 15.

Gomphonema lanceolatum A. SCHMIDT, Atlas Diatom. (1902) pl. 236, fig. 34.

Valve linear-lanceolate with attenuate ends. Length, 0.06 mm; breadth, 0.01; striæ almost parallel, 12 to 13 in 0.01 mm.

GOMPHONEMA CONSTRICTUM Ehr. var. **CAPITATA** (Ehr.) Cleve. Plate 3, figs. 12, 13.

Gomphonema constrictum Ehr. var. *capitata* F. HUSTEDT, Bacillar. (1930) 377, fig. 715.

Valve clavate with broad rounded apex. Length, 0.022 to 0.03 mm; breadth, 0.01 to 0.012.

GOMPHONEMA AUGUR Ehr. Plate 3, fig. 14.

Gomphonema augur F. HUSTEDT, Bacillar. (1930) 372, fig. 688.

Valve clavate with gibbous and capitate apex part. Length, 0.028 mm; breadth, 0.0085; striæ 12 in 0.01 mm.

EPITHEMIA ZEBRA (Ehr.) Kutz. var. **SAXONICA** (Kutz.) Grun. Plate 3, fig. 16.

Epithemia zebra (Ehr.) Kutz. var. *saxonica* F. HUSTEDT, Bacillar. (1930) 385, fig. 730.

Valve lunate with gibbous and dorsal sides. Length, 0.022 mm; breadth, 0.0085; striæ 12 in 0.01 mm. A fresh-water diatom.

EPITHEMIA TURGIDA (Ehr.) Kutz. var. **GRANULATA** (Ehr.) Grun. Plate 3, fig. 17.

Epithemia turgida (Ehr.) Kutz. var. *granulata* F. HUSTEDT, Bacillar. (1930) 387, fig. 734.

Valve linear-lanceolate with capitate ends. Length, 0.064 mm; breadth, 0.01. A fresh- and brackish-water diatom.

RHOPALODIA GIBBA (Ehr.) O. Mull. var. VENTRICOSA (Ehr.) Grun. Plate 3, fig. 18

Rhopalodia gibba (Ehr.) O. Mull. var. *ventricosa* F. HUSTEDT, Bacillar. (1930) 390, 391, fig. 741.

Valve broad-lanceolate. Length, 0.042 mm; breadth, 0.02.

NITZSCHIA AMPHIBIA Grun. Plate 3, figs. 12 to 22.

Nitzschia amphibia F. HUSTEDT, Bacillar. (1930) 414, fig. 793.

Valve lanceolate, narrowed towards the ends. Costæ 7 to 8, striæ 15 to 16, in 0.01 mm. Length, 0.012 to 0.04 mm; breadth, 0.034.

NITZSCHIA BREMENSIS Hust. var. SINICA var. nov. Plate 3, fig. 23.

Valve linear-lanceolate, slightly constricted in the middle, with acuminate and rounded ends. Costæ large, 8, striæ 24, in 0.01 mm. Length, 0.052 mm; breadth, 0.0885. Differs from the type in its broader valve. *Nitzschia bremensis* is known from fresh and brackish water.

NITZSCHIA FRUSTULUM (Kutz.) Grun. var. PERPUSILLA (Rabh.) Grun. Plate 3, fig. 24.

Nitzschia frustulum (Kutz.) Grun. var. *perpusilla* V. HEURCK, Synopsis (1880–81) pl. 99, fig. 6.

Valve lanceolate, attenuate at the ends. Costæ 15, striæ 20, in 0.01 mm. Length, 0.01 mm; breadth, 0.0025. A brackish-water diatom.

NITZSCHIA FASCICULATA Grun. Plate 3, fig. 25.

Nitzschia fasciculata V. HEURCK, Synopsis (1880–81) pl. 66, figs. 11 to 13.

Valve slightly sigmoid, narrow towards the ends. Length, 0.04 mm; breadth, 0.005; costæ 8, striæ 35, in 0.01 mm. A brackish-water diatom.

NITZSCHIA PALEACEA Grun. Plate 3, fig. 26.

Nitzschia paleacea F. HUSTEDT, Bacillar. (1930) 416, fig. 807.

Valve linear, attenuate towards the ends. Costæ 13 in 0.01 mm; length, 0.054 mm; breadth, 0.0025. Striæ very fine, indistinct. A fresh-water diatom.

NITZSCHIA PALEA (Kutz.) W. Smith. Plate 3, fig. 27.

Nitzschia palea F. HUSTEDT, Bacillar. (1930) 416, fig. 801.

Valve linear-lanceolate with truncate and rounded ends. Length, 0.017 mm; breadth, 0.008; costæ 15, striæ 35, in 0.01 mm.

NITZSCHIA PALEA (Kutz.) W. Smith var. GRACILIS var. nov. Plate 3, fig. 28.

Valve linear, in the middle part parallel, attenuate towards the ends. Length, 0.028 mm; breadth, 0.002; costæ 15, striæ 35, in 0.01 mm. This form is connected with var. *tenuirostris*.

NITZSCHIA CAPITELLATA Hust. Plate 3, fig. 29.

Nitzschia capitellata F. HUSTEDT, Bacillar. (1930) 414, fig. 792.

Valve linear-lanceolate, attenuate towards the ends. Ends capitate. Length, 0.0; breadth, 0.0034; costæ 11, striæ 35, in 0.01 mm. A fresh- and brackish-water diatom.

NITZSCHIA ACICULARIS W. Smith. Plate 3, fig. 30.

Nitzschia acicularis F. HUSTEDT, Bacillar. (1930) 423, fig. 821.

Valve filiform, gibbous in the middle, acuminate at the ends. Length, 0.068 mm; breadth, 0.003; costæ 15 in 0.01 mm.

HANTZSCHIA AMPHIOXYS (Ehr.) Grun. var. XEROPHILA Grun. Plate 3, figs. 32 to 35.

Hantzschia amphioxys (Ehr.) Grun. var. *xerophila* GRUNOW, Diatom. Franz Joseph Land (1884) 47.

Valve linear-lanceolate with rostrate ends. Length, 0.022 to 0.03 mm; breadth, 0.0052 to 0.0068; costæ 6 to 12 in 0.01 mm.

SURIRELLA ANGUSTATA Kutz. Plate 3, fig. 31.

Surirella angustata A. MAYER, Bacillar. d. Regensburg. Gewässer. (1912) 331, pl. 21, fig. 8.

Valve lanceolate, attenuate towards the ends. Length, 0.018 mm; breadth, 0.0058; costæ 6 in 0.01 mm. Common in fresh water.

ILLUSTRATIONS

PLATE 1

FIG. 1. *Cyclotella meneghiniana* Kutz.
2. *Cyclotella meneghiniana* Kutz. var. *tenera* Kolbe.
3. *Cyclotella stelligera* Cleve and Grunow.
4. *Melosira granulata* (Ehr.) Ralfs status x.
5. *Melosira granulata* (Ehr.) Ralfs forma *curvata* Grun.
6. *Melosira granulata* (Ehr.) Ralfs var. *angustissima* O. Mull.
7. *Melosira distans* (Ehr.) Kutz.
8. *Fragilaria capucina* Desm.
9. *Synedra vaucheriae* Kutz. var. *truncata* (Grev.) Grun.
10. *Synedra ulna* (Nitzsch.) Ehr.
11. *Synedra ulna* (Nitzsch.) Ehr. var. *biceps* (Kutz.).
12. *Synedra pulchella* Kutz. var. *lanceolata* O. Meara.
13. *Synedra rumpens* Kutz. var. *sinica* var. nov.
14. *Synedra rumpens* Kutz. var. *scotica* Grun.
15. *Eunotia lunaris* (Ehr.) Grun.

FIGS. 16 to 19. *Achnanthes hungarica* Grun.

FIG. 20. *Cocconeis placentula* (Ehr.) var. *euglypta* (Ehr.) Cleve.
21. *Neidium affine* (Ehr.) Cleve var. *amphirhynchus* (Ehr.) Cleve.
22. *Neidium hitchcockii* Ehr. var. *obliquestriatum* var. nov.
23. *Neidium productum* (W. Smith) Cleve.
24. *Caloneis bacillum* (Grun.) Meresch.
25. *Caloneis bacillum* (Grun.) Meresch. var. *trunculata* Grun. forma.
26. *Caloneis clevei* (Lagerst.) Cleve.
27. *Caloneis silicula* (Ehr.) Cleve var. *gibberula* (Kutz.) Grun.
28. *Navicula hungarica* Grun. var. *capitata* (Ehr.) Cleve.
29. *Navicula exigua* (Greg.) O. Mull. var. *sinica* var. nov.

FIGS. 30 and 31. *Navicula pupula* Kutz.

FIG. 32. *Navicula pupula* Kutz. var. *capitata* Hust.
33. *Navicula pupula* Kutz. var. *rostrata* Hust.
34. *Navicula lambda* Cleve var. *sinica* var. nov.
35. *Navicula americana* Ehr.
36. *Navicula cryptocephala* Kutz.
37. *Navicula cryptocephala* Kutz. var. *exilis* (Kutz.) Grun.
38. *Navicula meniscultus* Schumann var. *sinica* var. nov.

PLATE 2

FIG. 1. *Gyrosigma acuminatum* (Kutz.) Rabh.
2. *Stauroneis anceps* Ehr. forma *gracilis* (Ehr.) Cleve.
3. *Navicula cuspidata* Kutz.
4. *Pinnularia platycephala* Cleve var. *hattoriana* Meister.
5. *Pinnularia subcapitata* Greg. var. *paucistriata* Grun.

FIG. 6. *Pinnularia subcapitata* Greg. var. *asiatica* var. nov.
7. *Pinnularia interrupta* W. Smith var. *sinica* var. nov.
8. *Pinnularia subsolaris* (Grun.) Cleve.
9. *Pinnularia subsolaris* (Grun.) Cleve var. *interrupta* var. nov.
10. *Pinnularia viridis* (Nitzsch.) Ehr.
11. *Pinnularia gibba* Ehr.
12. *Pinnularia gibba* Ehr. forma *subundulata* Mayer.
13. *Pinnularia braunii* (Grun.) Cleve var. *amphicephala* (A. Mayer) Hustedt.
14. *Pinnularia platycephala* (Ehr.) Cleve forma.
15. *Amphora veneta* (Kutz.).
16. *Amphora ovalis* Kutz.
17. *Amphora ovalis* Kutz. var. *libyca* (Ehr.) Cleve.
18. *Amphora normani* Rabh.
19. *Amphora coffeaeformis* Agardh var.
FIGS. 20 and 21. *Cymbella tumida* (Breb.) Van Heurck.

PLATE 3

FIG. 1. *Cymbella tumida* (Breb.) Van Heurck var. *borealis* Grun.
2. *Cymbella turgida* (Greg.) Cleve.
3. *Cymbella ventricosa* Kutz.
4. *Gomphonema intricatum* Kutz.
FIGS. 5 and 6. *Gomphonema parvulum* (Kutz.) Grun.
FIG. 7. *Gomphonema parvulum* (Kutz.) Grun. var. *lagenula* (Kutz. Grun.) Hust.
8. *Gomphonema parvulum* (Kutz.) Grun. var. *subelliptica* Cleve.
9. *Gomphonema acuminatum* Ehr. var. *turris* (Ehr.) Cleve.
FIGS. 10 and 11. *Gomphonema acuminatum* Ehr. var. *sinica* var. nov.
12 and 13. *Gomphonema constrictum* Ehr. var. *capitata* (Ehr.) Cleve.
FIG. 14. *Gomphonema augur* Ehr.
15. *Gomphonema lanceolatum* Ehr.
16. *Epithemia zebra* (Ehr.) Kutz. var. *saxonica* (Kutz.) Grun.
17. *Epithemia turgida* (Ehr.) Kutz. var. *granulata* (Ehr.) Grun.
18. *Rhopalodia gibba* (Ehr.) O. Mull. var. *ventricosa* (Ehr.) Grun.
FIGS. 19 to 22. *Nitzschia amphibia* Grun.
FIG. 23. *Nitzschia bremensis* Hust. var. *sinica* var. nov.
24. *Nitzschia frustulum* (Kutz.) Grun. var. *perpusilla* (Rabh.) Grun.
25. *Nitzschia fasciculata* Grun.
26. *Nitzschia paleacea* Grun.
27. *Nitzschia palea* (Kutz.) W. Smith.
28. *Nitzschia palea* (Kutz.) W. Smith var. *gracilis* var. nov.
29. *Nitzschia capitellata* Hust.
30. *Nitzschia acicularis* W. Smith.
31. *Surirella angustata* Kutz.
FIGS. 32 to 35. *Hantzschia amphioxys* (Ehr.) Grun. var. *xerophila* Grun.

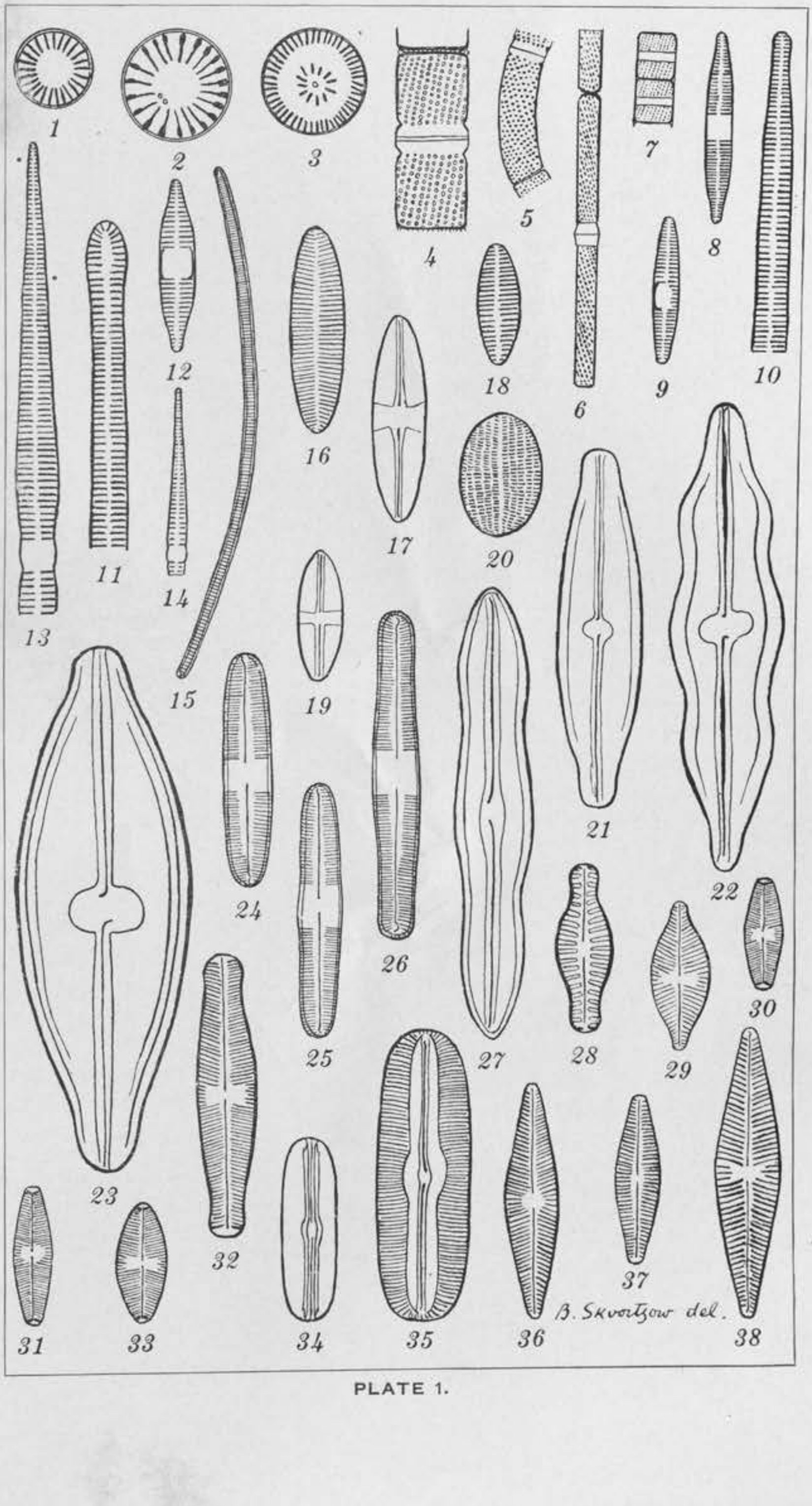
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PLATE 1.

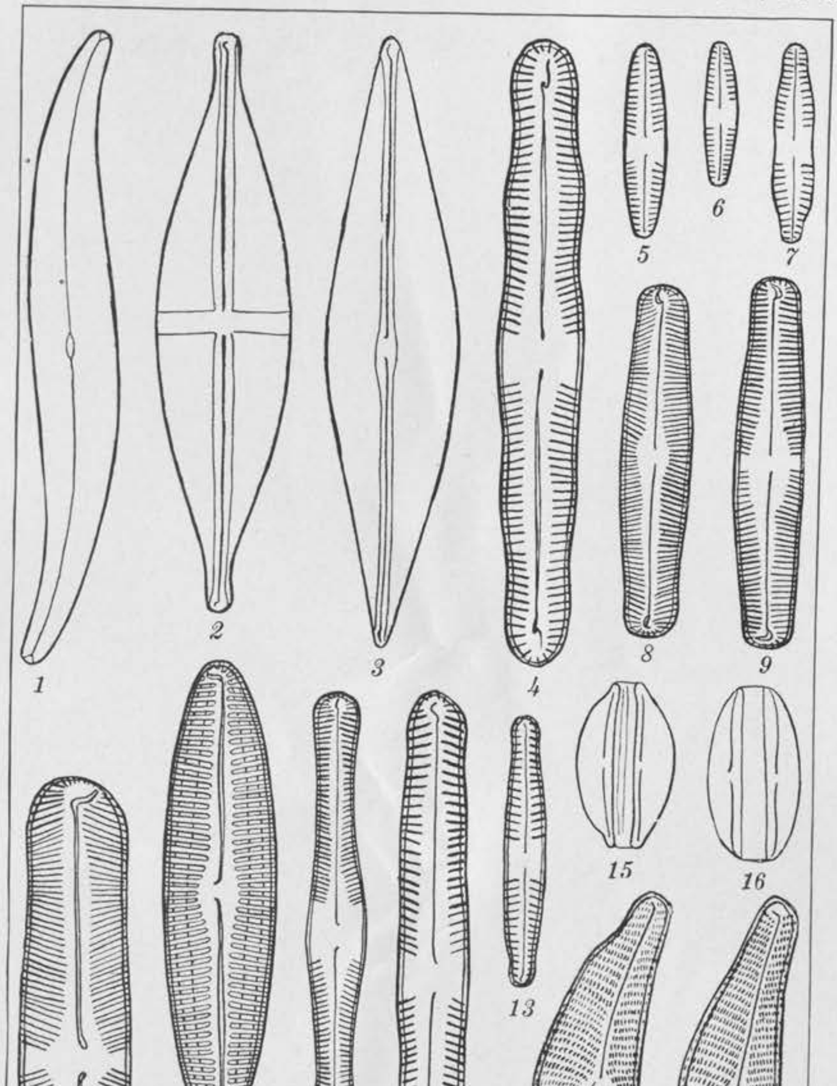

PLATE 2.

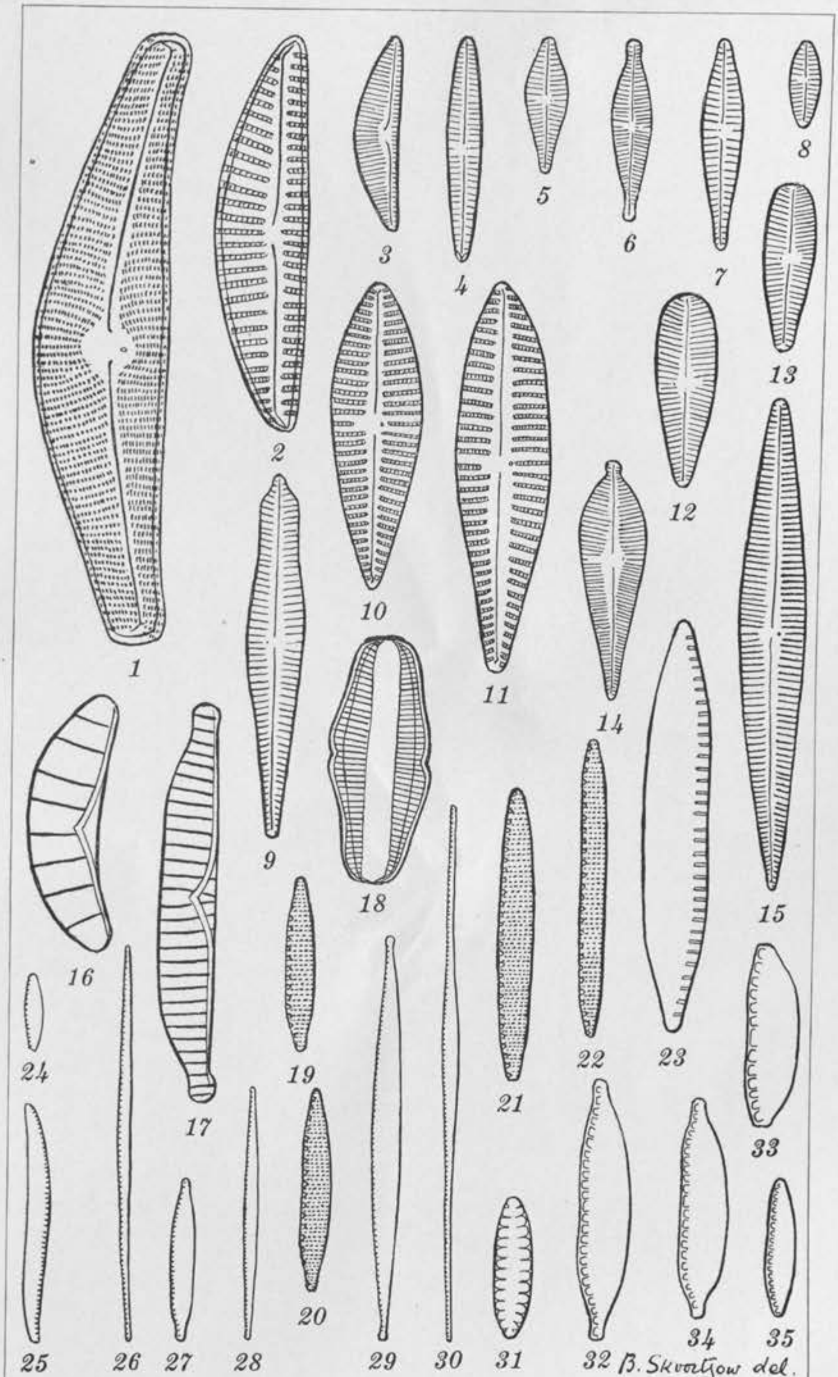
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PLATE 3.

SCOLYTIDÆ AND PLATYPODIDÆ:[1] NEW SPECIES FROM THE PHILIPPINE ISLANDS AND FORMOSA

By KARL E. SCHEDL

Of the Institut für angewandte Zoologie, Munich, Germany

XYLECHINUS FORMOSANUS sp. nov.

Reddish brown, opaque, 2.2 mm long, 2.17 times as long as wide. Front convex, darker than the general color, minutely reticulate and finely punctured.

Pronotum much wider than long (32 : 22), posterolateral angles rectangular, sides parallel on the basal fourth, then strongly convergent, apical margin broadly rounded; surface very feebly convex, uniformly, moderately, finely punctured and covered with scalelike hairs.

Elytra a little wider than (25 : 32) and 2.3 times as long as the pronotum, sides parallel, angulately rounded behind; base carinate, cylindrical on the basal three-fourths, uniformly convex behind, disc striate-punctate, strial punctures moderately large and densely place, interspaces moderately wide, convex and uniformly uniseriately punctured, from the punctures arise small inclined yellowish scales, the interspaces somewhat narrower on the declivity.

Type in my collection.

FORMOSA.

CROSSOTARSUS INUTILUS sp. nov.

Male.—Reddish brown, 3.5 mm long, four times as long as wide. Allied to *C. obtectus* m.

Front flat, opaque, densely roughly punctured, with scattered short erect hairs, rounded towards the vertex.

Pronotum much longer than wide (11 : 8), femoral grooves shallow, median sulcus long, surrounded by a narrow elongate patch of fine punctures, remaining surface shining, polished, subimpunctate.

Elytra wider than (9 : 8) and twice as long as the pronotum, sides parallel, with declivital armature similar to that of *C.*

[1] Thirty-second contribution.

obtectus m., but the lateral processes more strongly bent downwards and not so pointed; the declivital convexity more strongly developed, the puncturation of the disc much finer and the entire elytra strictly parallel-sided.

Female.—The female is of similar size and proportions. The front exactly as in the male, the pronotum with the patch of punctures much larger and long oval, the elytra obliquely narrowed behind, transverse at the apex, the elytral disc with the puncturation finer, the base of the third interstice elevated and transversely rugose, the declivity opaque, densely granulate, finely pubescent, convex above, perpendicular below.

Types in the possession of Mr. W. Schultze and in my collection.

LUZON, Mountain Province, Benguet, Baguio, 1,600 meters altitude (*W. Schultze*).

CROSSOTARSUS SALTATOR sp. nov.

Male.—Yellowish brown, 3.2 mm long, 3.2 times as long as wide. Allied to *C. decorus* m., from Sumatra, but without carinate interstices on the declivity.

Front flat, rounded towards the vertex, coarsely punctured, sparsely hairy.

Pronotum longer than wide (9 : 8), femoral grooves shallow, median sulcus inconspicuous, surface shining and very sparsely finely punctured.

Elytra wider than (9.5 : 8) and twice as long as the pronotum, sides subparallel, feebly arcuate, somewhat convergent towards the apex, apical margin transverse, the lateral processes following the convexity of the declivity, bent downwards, representing the continuation of the fifth and sixth interstices, pointed at the extreme apex; base not carinate, disc hardly noticeably lineate-punctate, evenly convex from behind the middle to the apical margin, all interstices similar and feebly carinate and with a row of fine setose granules.

Female.—Female of the same size and proportions as the male, the front more finely punctured, the median sulcus of the pronotum more strongly developed, elytral disc with the puncturation more distinct, the carinate interstices of the declivity more weakly developed, the lateral processes short and blunt.

Types in the possession of Mr. W. Schultze and in my collection.

LUZON, Nueva Vizcaya Province, Bayombong (*W. Schultze*).

CROSSOTARSUS TAYABASI sp. nov.

Male.—Reddish brown, 5 mm long, 2.7 times as long as wide. Allied to *C. subdepressus* m. but much stouter. I have separated this species out of a long series of *C. subdepressus* with which it seems to be associated on the food plant.

Front opaque, feebly transversely depressed above the epistomal margin, somewhat elevated and with a small puncture at the center, a few coarse punctures along the epistomal margin, densely but shallowly punctured and sparsely hairy above. Vertex separated from the front by an obtuse angle, antennal scape wider than long.

Pronotum quadrate, shining, femoral grooves distinct, median sulcus fine and long, surface with scattered fine punctures.

Elytra wider and 1.7 times as long as the pronotum, sides subparallel, cylindrical on the basal two-thirds, convex and with blunt downward-directed lateral processes behind; base feebly carinate, disc finely but distinctly lineate-punctate, the first row impressed, interspaces wide, polished, and with scattered fine punctures; declivity opaque, convex and granulate above, with a large lunate perpendicular impression below, the lateral processes broad triangular, the inner sides parallel.

Type in my collection.

LUZON, Tayabas Province, Quezon Park (*F. C. Hadden*).

CROSSOTARSUS SCHULTZEI sp. nov.

Male.—Blackish brown, 4 mm long, 4.6 times as long as wide. The declivital armature somewhat as in *Platypus aduncus* Chap., but belonging in the *Crossotarsi subdepressi.*

Front feebly broadly depressed, roughly densely punctured, with scattered erect yellow hairs.

Pronotum much longer than wide (13 : 9), femoral grooves long and deep, median sulcus very long and fine, surrounded by a very elongate patch of fine punctures, surface shining, hardly noticeably punctured.

Elytra hardly wider than pronotum and 1.95 times as long, base carinate, sides parallel, cylindrical, apex feebly convex, at the suture on the convexity emarginate, sutural corners at the apex produced, lateral processes very slender, the inner sides convergent, their apices somewhat blunt and with a small tooth external to the apical spur, a lunate depression from the processes to the suture; elytral disc with rows of hardly noticeable punctures except the first row, which is deeply impressed, inter-

spaces flat, polished, impunctate, granulate, and with yellowish pubescence on the upper declivital convexity.

Types in the possession of Mr. W. Schultze and in my collection.

LUZON, Mountain Province, Benguet, Mount Santo Tomas (*W. Schultze*).

CROSSOTARSUS INIMICUS sp. nov.

Male.—Reddish brown; 2.8 mm long, five times as long as wide. A very slender species of the *Crossotarsi subdepressi.*

Front flat, sparsely coarsely punctured, rounded towards the vertex.

Pronotum 1.4 times as long as wide, widest at the posterior angles of the very deep and long femoral grooves, from there strongly narrowed towards the base, median sulcus very long but extremely fine, surface finely reticulate, with scattered fine punctures.

Elytra as wide and twice as long as the pronotum, sides parallel, cylindrical, nearly horizontal on the disc, the sides at the apex produced to form short lateral processes, when viewed from above the apex broadly emarginate, the declivity reduced to a small narrow lunate perpendicular space, disc shining, very finely lineate-punctate, interstices flat, subimpunctate, base of the third without any remarkable puncturation.

Types in the possession of Mr. W. Schultze and in my collection.

LUZON, Mountain Province, Benguet, Mount Santo Tomas, on *Ficus* sp. (*W. Schultze*).

CROSSOTARSUS PERNANULUS sp. nov.

Yellowish brown, 2 mm long, 4.5 times as long as wide. This species is very closely allied to *C. inimicus* m., but is decidedly smaller, has the front separated from the vertex by an acute angle, the pronotum is subshining, 1.4 times as long as wide, the elytra as wide and 1.6 times as long as the pronotum, the lateral processes short and blunt, and with a small apical tubercle, the sides are serrate and feebly rounded, constricted, on a very short space before the lateral processes, the latter hardly produced beyond the transverse apical margin. The sex is rather uncertain.

Types in the possession of Mr. F. C. Hadden and in my collection.

LUZON, Laguna Province, Mount Maquiling, 400 feet altitude (*F. C. Hadden*).

CROSSOTARSUS FRACTUS Samps.

I have had the opportunity to compare my male specimens from the Philippines with the type, which is in the possession of Doctor Beeson at Dehra Dun. The variations within the species are rather remarkable, especially in regard to the declivital armature. Some specimens have the emargination at the suture distinctly wider than long, whereas in others it is strictly semicircular. The apical processes are from subparallel (the inner sides) to distinctly convergent, and there are also remarkable variations in size. All variations are not constant enough to justify the separation of subspecies or variations. The female, which has not been known, is described below.

Female.—Dark reddish brown, 4.7 mm long, three times as long as wide. Similar to the female of *C. squamulatus* Chap., but smaller and stouter.

Front flattened, with a depressed puncture medially, surface subshining, moderately finely punctured.

Pronotum quadrate, minutely reticulate, subshining, rather finely and sparsely punctured, a group of large punctures at each side of the anterior extremity of the short median sulcus.

Elytra but little wider (16 : 15) than the pronotum and 1.8 times as long, sides subparallel, slightly arcuate, broadly rounded behind; disc lineate-punctate, first row impressed throughout, the other only towards the base, interspaces flat, subconvex near the base, with scattered punctures, the base of the third with a few small but distinct transverse rugæ, apex strongly convex, granulate, and with short reddish pubescence.

Types in the possession of Mr. F. C. Hadden and in my collection.

LUZON, Laguna Province, Mount Maquiling, 400 feet altitude (*F. C. Hadden*).

CROSSOTARSUS FRAGMENTUS Samps.

A male specimen of the British Museum, which I would regard as a paratype,[2] I had the opportunity to see I would consider as distinct from the following male of *Crossotarsus squamulatus* Chap.

CROSSOTARSUS SQUAMULATUS Chap.

Male.—Dark brown, 5.6 mm long, 3.2 times as long as wide. Very closely allied to *C. fragmentus* Samps., but distinctly slenderer, elytra 1.77 times as long as wide, *C. fragmentus* 1.60 times as long as wide, the elytral declivity commencing farther

[2] Sharp, Coll. (1905) 303.

behind, more strongly convex, the sulci wider and the tuberculate-carinate interstice narrower, in spite of the smaller size the lateral emarginations of the declivity much larger, the lateral processes much more narrowed at the apex, the sutural emarginations narrow, much longer than wide, the lateral angles rectangular.

Front transversely depressed below, subopaque, finely areolate, densely, rather coarsely, punctured, with a depressed puncture medially.

Pronotum quadrate, median sulcus moderately long, surface shining, densely punctured, the punctures greatly varying in size.

Elytra with the fine striæ feebly impressed, the strial punctures fine.

Type in my collection.

JAVA.

Females I have seen from Malacca, Tempinis, 3–IX–1923, H. W. Woolley, in material of the British Museum and from the Malay Peninsula of the Imperial Institute of Entomology, London.

CROSSOTARSUS SEXPORUS sp. nov.

Female.—Dark reddish brown, 4.5 mm long, 3.3 times as long as wide. Closely allied to *C. koryoensis* Mur.

Front subshining, feebly convex, coarsely punctured, finely, longitudinally areolate above, gradually becoming punctured towards the vertex.

Pronotum quadrate, widest at the anterior edges of the moderately developed femoral grooves, median sulcus very long and deep, surrounded by a cordiform depressed space, which bears several small punctures and three large pores on each side, remaining surface shining and subimpunctate.

Elytra wider (14 : 13) and 2.1 times as long as the pronotum, of the same general shape and sculpture as *C. koryoensis*, but the base of the third interstice hardly elevated and without the transverse rugæ, but with a few fine punctures, the apex wider, along the suture not depressed, the apical face smaller and more transverse.

Type in my collection.

"Philippinen," without exact locality.

PLATYPUS SETACEUS Chap.

Female.—Dark reddish brown, 4.7 mm long, 3.1 times as long as wide.

Front deeply transversely concave on the anterior half, concavity shining, impunctate, the upper part abruptly elevated, convex, the lower limits triangular, densely covered with erect reddish hairs and densely punctured, rounded towards the vertex. The entire front similar to that of *P. luzonicus* m.

Pronotum quadrate, femoral grooves short and shallow, median sulcus long and fine, surrounded by a transverse oval patch of densely placed fine punctures, remaining surface finely reticulate and shallowly but coarsely punctured.

Elytra but little wider than pronotum (15: 14) and twice as long, sides parallel, feebly obliquely rounded behind, transverse at the apex; disc striate-sulcate, sulci moderately deep, punctures shallow, somewhat indistinct, interspaces feebly convex, with numerous fine punctures along the sulci, the first interspace finely granulate throughout, base of the third but little widened and densely granulate; declivity feebly convex above, perpendicular below, on the upper convexity the interstices narrow and densely granulate, opaque and subrugose below. Entire declivity with short erect pubescence.

Types in the possession of Mr. W. Schultze and in my collection.

LUZON, Mountain Province, Benguet, Baguio, 1,600 meters altitude (*W. Schultze*).

PLATYPUS TENELLUS sp. nov.

Male.—Dark brown, 5.2 mm long, three times as long as wide. Similar to *P. douei* Chap., but with different sculpture of the front and the pronotum.

Front opaque, flat, sparsely but coarsely punctured and feebly transversely elevated between the articulations of the antennæ.

Pronotum quadrate, shining, femoral grooves broad and shallow, median sulcus very short, surrounded by a subquadrate patch of fine densely placed punctures, remaining surface coarsely but shallowly punctured.

Elytra wider than pronotum (17.5 : 15) and 2.2 times as long, sides straight, diverging towards the posterior third, thence rather narrowly rounded to the apex, cylindrical on the basal two-thirds, gradually declivous and convex behind; disc striate-sulcate, sulci deep but without recognizable punctures, the first interstices narrow, very finely tuberculate, the others feebly convex and with numerous punctures along the sulci, the third and fifth a little wider than the others, base of the third not noticeably widened but with some densely placed punctures; declivital convexity with similar, low, uniseriately, finely tuberculate in-

terspaces in the upper half, at the middle of the convexity with a large hornlike structure in the continuation of the third interstice, the lower part subshining, impunctate.

Female.—Female similar to the male in size and proportions, the front flat, much smoother than in the male, the puncturation very fine and sparse, with some long erect hairs. Pronotum exactly as in the male, except for the decidedly finer puncturation. The elytra with the base of the interspaces 2 to 7 finely granulate, the declivity without the large teeth but with a low elevation, which is armed with a small granule, the upper convex portion more coarsely granulate and rather densely hairy.

Types in the possession of Mr. W. Schultze and in my collection.

LUZON, Mountain Province, Benguet, Mount Santo Tomas, on *Ficus* sp. and *Pinus insularis* Endl. (*W. Schultze*).

PLATYPUS LUZONICUS sp. nov.

Male.—Dark reddish brown, elytra darker, 6.5 mm long, 3.4 times as long as wide. The peculiar sculpture of the elytral disc would refer this species to the *Platypi dorso-sulcati*, but the general development of the elytral declivity and the close affinity of the female to *Platypus setaceus* Chap. indicate clearly that it belongs in the *Platypi sulcati*.

Front opaque except for the sparsely punctured epistomal margin, broadly depressed, with a median shining puncture, obtusely angulate on the vertex, the latter with three low shining carinæ, sparsely coarsely punctured and with long erect hairs.

Pronotum but little longer than wide, shining, femoral grooves hardly noticeable when viewed from above, median sulcus feebly developed, surrounded by a short oval patch of fine punctures, remaining surface shallowly but coarsely punctured and with long erect and sparse pubescence.

Elytra wider than pronotum (20 : 18.5) and twice as long, sides parallel, shortly and narrowly rounded behind, cylindrical on more than the basal two-thirds, obliquely convex behind; disc striate-sulcate, the sulci opaque and finely reticulate, appearing as depressed uniformly deep and wide striæ, the first two interspaces feebly elevated and uniseriately covered with shining tubercles throughout, the third wider, opaque, with a row of fine granules on each side close to the sulci and the base finely punc-

tured, the fourth and sixth are opaque like the first and second, but tuberculate on the apical half only, the basal half shining, punctured near the base, the fifth similar to the third, but the sculpture more feebly developed, the others shining, wide, and without any remarkable sculpture; declivity breaking off in an obtuse angle, the interspaces continued on the upper half, feebly carinate and uniseriately granulate, with a large tubercle at the fifth interspace at the commencement of the lower third of the convexity, which is opaque and irregularly covered with shining punctures.

Female.—Similar to the male in size and color, the pronotum more quadrate, the elytra slenderer.

Front deeply, transversely concave anteriorly and laterally up to the middle of the eyes, concavity shining and impunctate, convex, finely punctured and densely covered with long hairs above, the median line finely carinate, rounded towards the vertex, antennal scape very large, triangular, and with long erect hairs.

Pronotum with the sculpture as in the male, but the patch of punctures subcircular.

Elytra with the first interstice narrow finely uniseriately tuberculate, the other interstices feebly convex, shining, densely punctured along the sulci on the sides, base of the third finely tuberculate on a long narrow space; declivity more oblique, depressed on a triangular space below, the upper convexity densely granulate, the lateral margin of the depression somewhat elevated, the apex truncate.

Types in the possession of Mr. W. Schultze and in my collection.

LUZON, Mountain Province, Benguet, Mount Santo Tomas (*W. Schultze*).

PLATYPUS NOCUUS sp. nov.

Male.—Dark brown, 4 mm long, 3.7 times as long as wide. Another species of the *Platypi antennati;* similar to *P. excedens* Chap., but larger and with different sculpture of the declivity and pronotum.

Front flat, feebly depressed up to the articulation of the antennæ and along the median line up to the center, shining and coarsely punctured below, subshining and granulate-punctate above. Antennal scape wider than long and pale yellow.

Pronotum longer than wide (12 : 10), femoral grooves feebly developed, median sulcus shallow, not reaching the base, with a small elongate patch of fine densely placed punctures on each side of its anterior extremity, surface shining, finely punctured.

Elytra wider than pronotum (11.5 : 10) and twice as long, sides parallel on the basal two-thirds, narrowly rounded behind; disc finely lineate-punctate, the punctures remotely placed, interspaces polished, subimpunctate, base of interpaces 2, 3, 4, and 5 finely granulate; declivity opaque, commencing far behind the middle, feebly convex above, perpendicular below, the polished discal interspaces abruptly ceasing, but not elevated, in their continuation with rows of fine granules on the upper convexity, somewhat bluntly produced and with several granules at the middle of the declivity, a more constant granule on the second interstice of the perpendicular face.

Female.—Somewhat longer and slenderer than the male.

Front deeply concave on the anterior half, flat above, concavity polished and impunctate, upper portion irregularly punctured, median line carinate in the upper half of the concavity, shortly impressed above; antennal scape much wider than long, pale yellow, and fringed with long yellow hairs.

Pronotum in outline as in the male, median sulcus longer, surrounded by a larger patch of fine punctures, surface densely, finely reticulate, subshining, shallowly punctured.

Elytra with the sides parallel, transversely rounded behind, disc lineate-punctate, the punctures longer than in the male, the interspaces finely reticulate, the base of interspaces 2, 3, 4, and 5 more coarsely granulate; declivity feebly convex, granulate, with short yellowish pubescence.

Types in the possession of Mr. W. Schultze and in my collection.

LUZON, Mountain Province, Mount Santo Tomas, on *Ficus* sp. (*W. Schultze*).

PLATYPUS CURTUS Chap.

Female.—In size and proportions similar to the male.

Front flat, opaque, shortly pubescent, but distinctly densely punctured, the vertex with three elevated polished carinæ.

Pronotum quadrate, median sulcus short but distinct, the basal third of the punctured patch with three or four large porelike punctures on each side.

Elytra with the sides parallel beyond the middle, obliquely narrowed behind, apex transverse; disc indistinctly striate-punctate, interstices more confusedly punctured, base of the third strongly elevated, widened and transversely rugose, with a row of granules on the fourth and fifth, declivity shortly convex, perpendicular below, upper convexity densely, coarsely granulate, finely punctulate below, entire declivity opaque, and with erect dense pubescence.

Types in the possession of Mr. W. Schultze and in my collection.

NEGROS, Occidental Negros Province, Fabrica (*W. Schultze*). MINDORO, Mount Calavite (*W. Schultze*).

293954——6

CHIRONOMIDÆ FROM JAPAN (DIPTERA), IV

THE EARLY STAGES OF A MARINE MIDGE, TELMATOGETON JAPONICUS TOKUNAGA [1]

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THREE PLATES AND ONE TEXT FIGURE

There have been reported seven species of the genus *Telmatogeton* Schiner; namely, *T. sanctipauli* Schiner, *T. minor* Kieffer, *T. torrenticola* Terry, *T. abnorme* Terry, *T. trochanteratum* Edwards, *T. simplicipes* Edwards, and *T. japonicus* Tokunaga; and the majority of them, excepting the two Hawaiian species, are true marine in habitat. Studies of their biology are incomplete, and I report here more details of the structures of immature forms and some ecologic observations on the last species at Tottori, Karo.

These studies were made under the direction of Prof. Dr. Hachiro Yuasa, who has my hearty thanks. I am also deeply indebted to Prof. Dr. K. Okada for the use of equipment at the Seto Marine Biological Laboratory of the Kyoto Imperial University.

ECOLOGIC REMARKS

The size of this fly seems to vary in different localities. Specimens collected on the coast of the Pacific Ocean, at Wakayama, Seto, in June, 1930, are small, measuring 2.5 to 3 mm in length in the imaginal stage and 5 to 6 mm in the full-grown larval stage; while those obtained on the coast of the Japan Sea, at Tottori, Karo Harbor, in July, 1931, are large, being 4 to 4.5 mm in the adult form, 5.9 to 6.8 mm in the pupal stage, and 9 to 10 mm in the full-grown larval condition. These differences in size are probably due to the different conditions of the algal food rather than to the different localities themselves. The small specimens were found on the algal breeding bed composed

[1] Contribution from the entomological laboratory of Kyoto Imperial University, No. 43. Contribution from the Seto Marine Biological Laboratory of Kyoto Imperial University.

of *Monostroma* sp. on the ordinary tidal zone of a rocky shore, where this alga was very much damaged and faded, already being covered by shore sand at this season. The large specimens were taken from a breeding bed consisting of *Ulva pertusa* on stones at the estuary, and at this season the growth of this alga was still luxuriant. In the spring of 1934 I visited Seto again and obtained many vernal forms. These specimens are far larger than the summer forms of the same locality, being as large as the specimens at Karo; they were colonizing on *Monostroma* sp., which was most luxuriant in this season. The sexual difference in size is little and obscure.

Both sexes are nocturnal in habit, being most active in the evening about three hours after sunset, and imagines are usually resting in the daytime on the shaded side of a rock. Occasionally on a cloudy day, and rarely even in the direct sunshine, some individuals are actively scampering and ovipositing. When the fly is at rest, the body is closely applied to the substratum with the six long legs outstretched, as in the crane flies, supporting the body with only two distal joints of each tarsus. When the fly rests on a plain surface, either horizontal or vertical, the angles between the legs are as follows: 33° between the forelegs, 59° between the fore and middle legs, and 75° between the middle and hind legs.

The imagines rarely take flight unless molested, mating and swarming taking place only on the rock surface, and when disturbed by the on-coming waves, they adroitly fly up momentarily and resume active scampering and oviposition as soon as the waves recede. Thus they usually are found about their breeding place, but they can fly for some distance. On a calm evening, from 8 to 10.20 p. m., six female and seven male adults were obtained at a light screen set at about 600 meters from the habitat of this fly.

In size, shape, color, and structure the eggs closely resemble those of the related genus *Paraclunio* observed by Saunders. The female, soon after emergence, contains 150 to 190 mature eggs (168 mean for 20 flies), and they are almost all laid during the life of the fly. The eggs are placed singly in small crevices or pits of rock surface, as in *Paraclunio alaskensis* Coquillet, and never laid in a mass or single layer on the smooth surface as in the fresh-water species *Telmatogeton torrenticola* Terry. During oviposition, as in the marine crane fly *Limonia* (*Dicranomyia*) *trifilamentosa* Alexander, the female inserts the ovi-

positor into a crevice and flutters the wings by a rapid bobbing motion. The surface where the eggs are laid is never dry.

The adult females and males are attracted to light, and the number collected of each sex is subequal. The females collected at light had almost completed oviposition; ten flies contained mature eggs as follows: 0, 0, 0, 0, 0, 1, 1, 2, 2, 18. This is different from the observations on certain marine flies, such as *Tanytarsus boodleæ* Tokunaga and *Limonia monostromia* Tokunaga, studied at the Seto Marine Biological Laboratory by M. N. Omori and by myself.

The larval quarter of this species is never under the low tidal mark or in the rock pool but confined to the tidal zone between the upper and lower tidal lines, as already stated by Hesse and by myself. The nest cases of the immature forms are usually single and built under individual algæ. The nest is tubelike, firm, consists of sand particles and silky threads, and is not provided with special lids at both ends. The last is true even of the pupal nest. The entire larval body is inclosed within the tube, thus differing from *T. sanctipauli* and *T. minor*. Molting and pupation take place in the original larval nest case. Before pupation the nest is thickened by additional sand particles gathered by the prepupal larva. In the early stages the larvæ, in building their loose nest cases, often utilize the natural tunnellike folds in the algal fronds, and often migrate about in the wet condition of the quarter. In the later stages, after the second stadium, the position of the nests on the rock surface is limited to the bases of the algæ, contrary to the observations of Hesse, and the larva rarely creeps out of the nest case even in the wet or submerged condition. The direction of the nest tube seems to be irregular and not related to the shape of the algal base or to the inclination of the substratum (text fig. 1).

The food found in the larval stomach consists of many fragments of the living alga and a small quantity of the dead alga, mingled with sand particles and sedentary diatoms. Thus the main food item seems to be the living algæ used for their shelter, as in the African *Telmatogeton* species, which live on *Porphyra capensis* and *P. vulgaris;* and the greenish brown appearance of the living larvæ is due to these living algal fragments contained in the stomach. The tidal rhythm often affects the feeding habit of marine insects, as I have pointed out in the case of certain marine crane flies, but the larvæ of this fly seem to show no distinct rhythmic habit in feeding, due probably to the

fact that the larvæ continue to take food in the wet condition, even after the recession of the tide.

One of the distinct effects of the tidal rhythm is shown in the emergence of the imagines. The emergence of this fly never occurs in the floating condition as among the Chironomidæ in general or in the submerged condition as among the Simuliidæ and the Blepharoceridæ in general, but takes place only in the exposed condition in the ebb tide. In the field, pupal exuviæ always remain in the pupal cases as in the hygropetric midges. The emergence commences immediately after the tide has receded and lasts to the next flood tide. When the mature pupæ are artificially submerged in the water at the period of emergence they all die in various states of the process of the emergence. The periodicity of the emergence is shown only in the natural condition, and not retained long but easily disturbed in the ever-exposed condition. The duration of the pupal period observed in the laboratory in summer is about 2.5 days, varying much in different individuals, from 47 to 72 hours, the mean duration for ten pupæ being 56.7 hours. This length of the pupal period is far less than that of *T. sanctipauli* obtained by Hesse, who recorded 4 to 7 days or more in the laboratory. The process of emergence of the female was observed in the laboratory, from which the following data were obtained:

Process of emergence in the laboratory at 5 p. m., July 5.

	Min.	sec.
Pupal thorax wriggled out from alga	2	00
Abdominal tip shore silvery	7	00
Entire body shone silvery	16	00
Imaginal abdomen began to move irregularly within the pupal skin	16	30
Middorsal suture split in T-shape	17	00
Complete emergence	17	55
Walked slowly and rested quietly	18	00
Meconium dropped down	18	45
Suddenly scampered about with fluttering wings	18	45
Rested quietly	19	30
Actively scampered about	19	50
Taken on the wing	20	00
Body normally tinged	35	00
Total process	33	00

In the field this process is usually completed in about thirty minutes. The pale imagines soon after emergence are also active in swarming, mating, and scampering, like the old dark flies, but oviposition is not shown by these young females. The turning of the male hypopygium is already exhibited within the pupal skin before the emergence, and occurs in the irregular movement at the shining stage of the pupal skin. The seasonal emergence of this fly is not so distinct as in the marine genus *Clunio*, imagines being found almost throughout the spring and summer seasons, and the growth of the larvæ collected from one colony in the same season is also very irregular. On this point Hesse stated that "there is reason to believe that there is more than one generation in a year," and judging from my observations there may be two generations in a year, imagines emerging twice, in the spring and summer seasons.

The duration of the imaginal life of imagines that were reared in the laboratory was about 20 hours in both sexes and the following data were obtained: 17, 22, and 22 hours in the female and 20 in the male. These flies in the laboratory did not show copulation or oviposition. Honey water was given them for food. This fly always colonizes on the hard substratum between the tide marks, and only three species of littoral green algæ are known as the host plants; namely, *Enteromorpha compressa*, *Ulva pertusa*, and *Monostroma* sp. Moreover, the rock surface where the colonization is settled always shows a sharp slope toward the water and is kept clean, as the débris, drift, and sand washed up by waves and in the ebb-tide water are not retained, as in the case of the algal bed of *Enteromorpha intestinalis*. The last-mentioned alga is one of the most prevalent plants found in a similar condition on the tidal zone to the above littoral species of algæ, and various shore chironomids and crane flies, but not *T. japonicus*, have been reported from this alga. From observations at Karo, the main animals associated with this marine midge showing a close spatial relation to the same littoral alga, *Ulva pertusa*, are one of the Janiridæ (Isopoda) and a species of *Orchestia* (Amphipoda) (text fig. 1).[2]

[2] These animals were kindly determined by Dr. K. Stephensen and Dr. K. Akatsuka, respectively.

A census of these animals on the rock surface having the largest population of *T. japonicus* is given in Table 1.

TABLE 1.—*Population of the biotic elements on the rock having the largest population of Telmatogeton japonicus Tokunaga, observed in July, 1931.*

Biotic element.	Individuals per square meter.	
		Per cent.
Telmatogeton japonicus	1,470–1,660	28.18–29.38
Pupæ	550– 560	9.51–10.99
Larvæ	920–1,100	18.39–18.68
Amphipoda	640– 650	11.04–12.78
Isopoda	1,800–1,900	32.26–35.97
Ulva pertusa	1,670–1,680	28.52–33.37

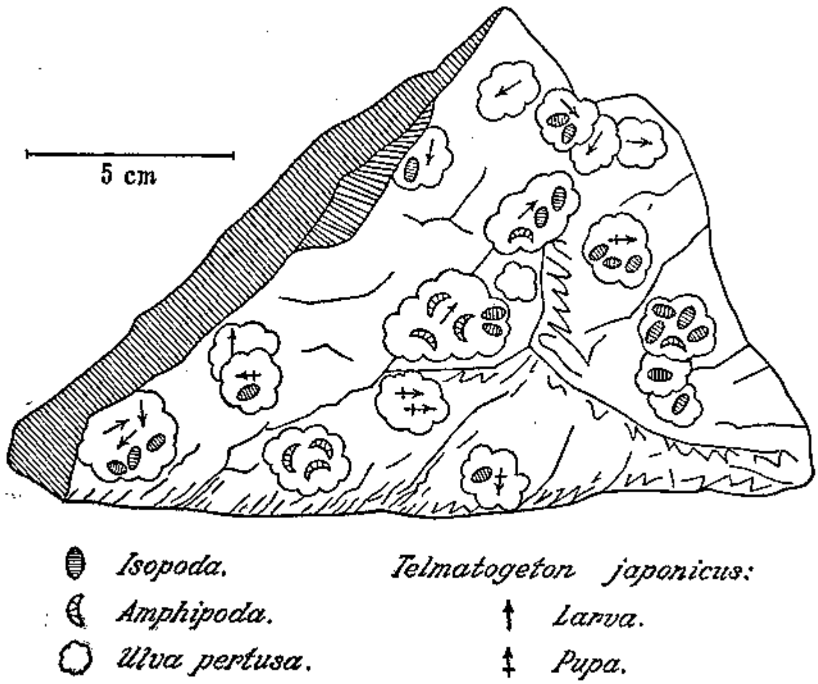

FIG. 1. Distribution of various littoral animals associated with the green alga on the surface of a piece of stone that shows a high population of the insect *Telmatogeton japonicus* Tokunaga.

It may be worth noting that the colonization of the Japanese species is found in various conditions of salinity, such as about 3.2 per cent salt (NaCl) on the Pacific coast and about 1 to 3.1 per cent on the coast of the Japan Sea, as I have already re-

ported (1933). Experimentally a dozen or more normal imagines were obtained, which were reared with fresh water alone from young second and third instars (1932 and 1933). Hesse also reported that "immersion in fresh water or sea water does not appear to affect them in any way and one specimen was left in fresh water for several days without showing any signs of being uncomfortable." Judging from these biologic observations, together with those on the Hawaiian fresh-water species, the genus *Telmatogeton* is thought to suggest a transitional mode of life between land and sea, both in habitat on the intermediate shore zone and in physiologic resistance to the salinity of sea water, differing from the other genera of the marine subfamily Clunioninæ in the latter point.

MORPHOLOGY OF THE LARVA

GENERAL REMARKS

The larva is elongated and cylindrical, of the usual chironomid type, and closely resembles that of *Paraclunio*. The body is semihyaline and pale green or greenish brown according to the algal color of the stomach contents. The development of the setæ of the body is very poor. The head is brown, darker along the occipital foramen, cephalic margin, lateral margins of the front, and at the base of the mentum. Distinct paired eyespots are present on the cephalolateral side of the vertex and each eyespot consists of closely situated masses of pigment; namely, a large posterior mass and two or three small anterior pigment masses. Terry states that these eyespots are wanting in *T. torrenticola*. The mandibles are provided with seven teeth, while in *T. torrenticola*, *T. sanctipauli*, *T. minor*, and *Paraclunio alaskensis* they are provided with five teeth, and the setæ of the brustia also differ in number from those of *T. japonicus*. The general shape of the mentum is related to that of *P. alaskensis*, and the number of teeth is nearly the same as in *T. sanctipauli*, but the shapes of the teeth are quite characteristic for the species. In the present larva there are eleven teeth, and the median tooth is comparatively small and sharply pointed, while in *T. sanctipauli* the number of the teeth varies between nine and eleven, and the middle tooth is very large; in *T. minor* it varies between eleven and thirteen, and the middle tooth is not sharp; in *T. torrenticola* there are fifteen. Both the pre- and postclypeus are well developed and the frontoclypeal suture

of a trapezoid plate, postclypeus proper, and the lateral membrane. The chitinized plate is not provided with setæ, but on the lateral membrane there is a very large seta, which grows on the conspicuous tubercle. The preclypeus is obscurely demarcated from the labrum by a pair of incomplete furrows on the lateral membrane of the clypeolabrum and provided with a subtriangular plate, preclypeus proper, on its meson and a pair of ordinary setæ on its lateral membrane. The labrum is membranous, provided with a pair of simple setæ on its dorsal side, and various cuticular appendages on its cephalic smooth membrane, which is somewhat dilated ventrad. On this swollen area, as shown in Plate 2, fig. 10, giving the cephalic aspect of the labrum, there are paired brushlike setal groups on the lateral sides, three pairs of hyaline trichoid sensillæ, which are curved ventrocaudad on the meson, two pairs of sensory pegs on the dorsomeson, and two pairs of minute hyaline trichoid sensillæ, which are extended mesad and located near the sensory pegs. On the entire dorsal membrane of the clypeolabrum minute round dots of chitinization are densely arranged. Each dot represents the external surface of the conical tuberclelike chitinization of the cuticular layer, which is internally thickened.

The lateral chitinization of the clypeolabrum consists of three different sclerites in the typical specimen, two of which are homologous with the clypealia and torma. The remaining one is apt to be overlooked, but this chitinization is widely shown in Nematocera, and the origin is considered as the secondary chitinization of the lateral margins of the labrum, for which I propose the term "labralia." In the present case the clypealiæ are well developed and found on the lateroproximal margins of the clypeolabrum. The tormæ are firmly fused with the labraliæ and represented by the blunt ventral projections. The labraliæ are fused with each other at the cephalic extremity, forming a framework to support the labral membrane, and on the ventral side these marginal sclerites bluntly project mesad for the articulation of the premandibles.

Although the ventral side of the clypeolabrum (Plate 2, figs. 8 and 10) is not definitely divided into the epipharynx and epigusta, the region of the epigusta is quite smooth and membranous, while the region of the epipharynx is provided with various appendages that are characteristic for the chironomid larvæ. Of these appendages the most conspicuous organs are

the paired premandibles, which are articulated to the special projections of the labraliæ, each provided with a set of antagonistic muscles at its basal projections. The distal half of the premandibles is thin, somewhat concave on the mesal aspect, and dentated into three blunt teeth on its edge, as in Plate 2, fig. 12. The membrane mesad of the premandibles is swollen and spinous. On the cephalic region of the epipharynx there is a U-shaped chitinization, which is formed by the fusion of originally paired secondary chitinization of the membrane. Along the arms of this U-shaped structure there are paired groups of minute hooklets. These hooklets (Plate 2, fig. 11) are hyaline and flat, and those of the mesal side are finely serrated, while those of the lateral side are simple and slender. On the cephalic margin of the epipharynx there are three minute, hyaline, scalelike combs, which are finely and irregularly serrated on the distal margin. Besides these cuticular structures there is a pair of brown thickened patches on the meson caudad of the U-shaped sclerite or mesad of the premandibles.

The mandibles (Plate 2, figs. 8, 13, and 14) are symmetrical in structure, comparatively slender, and each has two long setæ on the ventrolateral surface. There are seven mandibular teeth. The distadentis is somewhat slenderer than the proxadentes, but there is no distinct differentiation between them. At the base of the dental row is a strong hyaline seta. The brustia is represented only by a proximal group of simple setæ, which are on the membranous area at the attachment of the retractotendon, and the number of setæ is usually six. The extensotendon is slender, but the retractotendon is very large, thickly chitinized, and oval.

The maxilla (Plate 2, fig. 8; Plate 3, figs. 16 and 17) is membranous, connected with the ventrocephalic margin of the vertex by the broad maxacoria, and consists of two chitinized plates and two blunt distal membranous lobes. These two sclerites are the cardo and the stipes. The stipes is reduced into a small elongated sclerite on the dorsal side of the maxilla at the base of the lateral membranous lobe, and the ventral part of the stipes is reduced completely. The cardo is large, located on the ventral side, and its mesal part is bent dorsolaterad. Thus, as the result of the reduction of the stipes, the inner membranous lobe is directly supported by the semicircular cardo at its base.

The inner lobe is the lacinia. This membranous projection is subtriangular, thickly fringed with special setæ; the setæ on the cephalic margin are delicate and slender (Plate 3, fig. 16, *c*), and those on the mesal margin are long, stiff, semihyaline, and somewhat swollen at the base (Plate 3, fig. 16, *d*). On the ventral surface there are two long ordinary sensory setæ, and on the dorsal surface there is a group of sensory pegs (Plate 3, fig. 16, *b*).

The lateral lobe is the palpifer. The ventral surface of the palpifer is thinly membranous, very finely pubescent, provided with two long ordinary setæ on the basal region, which are located on the common basal chitinization, and with two sensory setæ on the meson, which are flat, somewhat blade-shaped, and each is attached to the individual tubercle (Plate 3, fig. 16, *e*). The dorsal surface is covered with the small pale brown scale-like structure that is shown in Plate 3, fig. 16, *a*. The maxillary palpus (Plate 3, figs. 17 and 18) is small and nonsegmented, located in the socketlike membranous concavity on the distal region of the palpifer. On the distal membrane of the maxillary palpus are usually eight minute sensillæ, as shown in Plate 3, fig. 18.

The labium is represented only by the dentated mentum, completely losing its palpi and membranous structures as is generally the case in the Chironomidæ. The mentum (Plate 2, fig. 8) is broad, thickly chitinized, with eleven teeth, including the large median and a pair of the most-lateral minute teeth. The setæ are wanting. The submentum, which is usually known as the fanlike lobe, is completely atrophied.

The hypopharyngeal structures (Plate 3, fig. 15) are comparatively well developed. The dorsal surface of the hypopharynx is membranous and provided with numerous spines, which are directed backwards. The lateral sides of the hypopharynx are supported by a pair of elongated sclerites, pharyngea-lingulæ, which are provided with two tendons on each caudal end that may be homologous with the linguacuta and paralingua tendon, being the pharyngea tendon atrophied. The salivos is found between the cephalic ends of the pharyngea-lingulæ and supported by the salivia. The salivia consists of two thinly chitinized plates; the dorsal plate is broad, while the ventral is narrow, and the two plates are directly connected with the cephalic ends of the pharyngea-lingulæ on their lateral corners.

The common salivary duct is comparatively short and distinctly dilated before the aperture. The ventral side of the hypopharynx is represented by the ventral plate of the salivia, which is connected with the dorsal side of the mentum by a narrow, delicate, membranous oscula. The special structure composed of the setæ is connected with the ventral plate of the salivia. The setæ of this structure are featherlike, stiff, pale brown, finely serrated on the lateral sides, more or less curved dorsad (Plate 3, fig. 15, *f*), and arranged in five or six rows. The small setæ are arranged on the dorsocaudal region, and the majority of the long setæ are located on the membranous areas near the lateral sides of the ventral plate of the salivia.

THE THORAX AND THE ABDOMEN

Of the three thoracic segments the prothorax is large and the remaining two segments are very small, being smaller than those of the abdomen except for the ultimate one. The setæ are very poorly developed and the great majority of them are very delicate and slender. The distribution of the setæ on the prothorax is somewhat different from that of the following two segments. On the prothorax three pairs of minute setæ are found on the anterior region of the tergum near the cervacoria and two pairs on the sternum near the base of the pseudopods. Of the lateral pairs one pair is long and comparatively distinct, and each consists of two ordinary setæ. On each of the remaining thoracic segments one minute seta is found on the anterior region of the lateral fold and three pairs on the sternum, and often some of these setæ consist of double setæ. The anterior pseudopods are quite contiguous, being incompletely separated by the shallow furrow and provided with numerous, simple, small brown hooklets on the distal region, but on the median furrow the hooklets are quite wanting. These hooklets are arranged on the oval area on each pseudopod, and the majority of them are very minute, but those of the anterior margin are long and slender.

The setæ on the abdomen are also very poorly developed and their distribution is subequal to each of the abdominal segments except for the two posterior ones. Generally, on the abdominal segment, there are two pairs on the tergum of which the anterior is large, a long single seta on the posterior region of the lateral fold, two pairs on the sternum of which the posterior is distinct,

and two simple setæ on the lateral side of the sternum close to the lateral fold. On the ninth abdominal segment there are two pairs of conspicuous setal groups on the posterior region of the tergum. Each setal group consists of two long stiff ordinary setæ growing from a common basal ring not provided with a common basal tubercle, differing in this from most species of the Chironomidæ. These caudal setæ are thought to be inconspicuous in certain related species, judging from the figures given by Johannsen and Saunders. The sternum of the ninth segment usually is not provided with setæ, but in the male on the meson of the sternum there is a slight furrow, which indicates the rudiment of the genital aperture, and in the female the genital rudiment is found between the eighth and ninth sterna. The ultimate segment is very small; there is one pair of ordinary setæ on the posterior region of the tergum and a single seta on the lateral side. The posterior pseudopods are comparatively short, but strong, deeply separated from each other, and each is provided with nineteen chitinized hooks on its distal region. These hooks are various in size, not serrated but all simple, arranged into about three circular rows on the distal end, and those of the peripheral rows are smaller and more sharply curved than those of the inner rows. The anal and caudolateral gills are all wanting as in the marine forms in general.

MORPHOLOGY OF THE PUPA

GENERAL REMARKS

The pupa is cylindrical, and both ends are obliquely truncated and more or less flattened. These oblique surfaces of the extremities are more thickened than in the other parts. In all probability these structures mainly serve for the protection of the quiescent pupa in the open cylindrical nest case. Especially, the peculiar abdominal termination is thought to serve partially to avert the danger of the pupa being washed away from the unclosed nest by waves, together with the small paired hooks provided on the ventral side of the caudal extremity, besides serving as a piston in the tube to force the pupa out to the surface when it is ready to emerge, as suggested by Saunders. Terry described this terminal structure as a suckerlike structure, but Saunders said that no such function can be ascribed to it.

Although neither Terry nor Saunders has mentioned it, in both sexes of the present species there is a pair of small but distinct hooks on the ventrocaudal side of the anal disc, as in *T. sanctipauli* and *T. minor*. This chitinized anal disc is thought to be an obvious character for the group including *Telmatogeton* and *Paraclunio*, differing from the group including *Clunio*, although the immature forms of the other genera of the Clunioninæ are little known.

The coloration of the pupa differs with the stage of development; in the early stage it is pale yellowish and semihyaline, darkening gradually on the anal disc, head, thorax, wings, and legs, and before the emergence the entire body appears dark brown. The pupal exuvia is pale brown on the head, thorax, anal disc, and sheaths of wings and legs and quite hyaline on the abdomen. The sexual difference is shown only on the genital sheaths; on the other structures it is very obscure.

In comparison with the other known pupal forms of *Telmatogeton*, the following structures of *T. japonicus* may be pointed out as the distinct differences: Head not distinctly bilobate apically, abdominal segments not provided with the anterior transverse shagreened bands, first abdominal segment without the paired lateral lobelike prominences, differing in this character from *T. sanctipauli*, anal disc of the female not distinctly elongated, differing in this from *T. minor* and *T. sanctipauli*, and prothoracic respiratory organ characteristic in shape for the species.

THE HEAD

The head (Plate 1, figs. 1 to 3) is comparatively broad, flattened and rugous on its surface, and situated on the ventrocephalic end of the body.

The sheaths of the antennæ are small, arising from the cephalic margin of the head, extending along the cephalic margin of the head but not far beyond the middle of the lateral margin of the vertex, and the sheaths are shallowly constricted according to the segmentation of the adult antennæ. On the dorsal side at the base of the antennal sheaths is a pair of conspicuous setæ, and there is a pair of minute papilliform projections on the dorsomeson of the head.

The ventral surface of the head is divided by the shallowly depressed epicranial suture into the lateral halves of the vertex

and the median frontoclypeus. This epicranial suture is never split in the process of emergence, and the imaginal head comes out through the cervical opening in this species. The area of the compound eye is very large, somewhat reniform, and hyaline in the exuvia. There is a pair of small setæ on the caudal side of the vertex. The frontoclypeus is large, somewhat triangular, and devoid of sensory and ordinary setæ.

The labral sheath is small; the labial sheaths are minute and separated from each other. The sheaths of the maxillary palpi are comparatively large for the small adult palpi, closely extended along the caudal margin of the vertex, and reach as far as the lateral margin of the head.

THE THORAX

The cephalic half of the thorax in height suddenly decreases forwards. The middorsal suture is distinctly marked throughout the prothorax, præscutum, scutum, and scutellum. This suture and a transversal suture of the cervacoria, which is shown by a chained line in Plate 1, fig. 2, are split in the process of emergence. The thoracic appendages are tightly held close to the ventral side of the body. The lateral margin of the thorax, cephalad of the wing base, is distinctly folded ventrad, forming a thickly chitinized ridge.

The prothorax is not distinctly demarcated from the mesopræscutum, and on its meson it seems to be separated into triangular lateral halves by the prolonged præscutum in the dorsal aspect. On the lateral margin of the pronotum is a pair of broad, flattened, ax-shaped, respiratory horns. The horns are closely similar in shape and structure to those of *P. alaskensis* described by Saunders. The tracheal trunk within a horn is dark brown, distinctly dilated, cylindrical, and slightly constricted before the opening. The opening is cuplike, provided with a dark ring and fringed processes of the lip, which are radially arranged. On the dorsal side near the base of the prothoracic respiratory horn there is usually an isolated seta and two closely arranged setæ.

The dorsum of the mesothorax consists of the scutopræscutum, scutellum, and postscutellum. The former two regions are rugous and indistinctly separated from each other by an incomplete shallow depression, but the last region is distinctly demarcated by a deep transversal furrow and quite smooth.

On the posterior part of the scutopræscutum there are two pairs of minute and a pair of distinct setæ, which are arranged transversally before the scutellum. A single distinct seta is found in the position corresponding with the adult prealar setæ. The scutellum and postscutellum are devoid of setæ. Between the postscutellum and the base of the wing the parascutella is partially visible in the dorsal aspect. The dorsum of the metathorax is not visible externally, being deeply hidden within the invagination between the thorax and abdomen.

The sheaths of the wings are extended ventrocaudad close along the body, ending before the caudal margin of the second abdominal sternum, and the distance between the tips of the wing sheaths is comparatively short. The anal angle of the wing sheath is well developed and the tip of the sheath comparatively sharp.

The sheaths of the legs do not extend caudad beyond the caudal margin of the second abdominal sternum as in the wing sheaths. The major parts of the paired sheaths of the fore and middle legs, including the tibiæ and tarsi, are extended caudomesad, forming a V, but not closely contiguous on their distal regions. Moreover, the sheaths of the fore and middle legs on one side are arranged in parallel position. The foreleg sheath is extended along the cephalic margin of the wing sheath and entirely visible in the ventral aspect, while the tarsal region of the middle-leg sheath is hidden under the wing sheath and ended before the tip of the foreleg sheath. The major part of the hind-leg sheath is not visible externally, being hidden under the preceding legs and wing. Under the wing sheath the hind leg is turned thrice, ending near the tip of the wing sheath, and the distal three tarsal joints of the hind leg are arranged along the caudal margin of the wing sheath and externally visible.

THE ABDOMEN

The cephalic seven segments are normal in type and subequal in shape and structure to each other, while the remaining terminal segments are highly modified for the genital sheaths and anal disc.

Generally an abdominal segment is provided with a U-shaped marginal chitinization each on the tergum and sternum, paired pale brown spinous patches on the lateral sides near the ends of the arms of the U-shaped chitinization, and several delicate

minute setæ. The arrangement of the setæ is as follows: Two pairs on the dorsocephalic region, one pair on the dorsocaudal, one pair on the ventrocephalic, two pairs on the ventrocaudal region, and on the lateral side two setæ on the cephalic region and a single seta on the caudal region. The first, second, third, and seventh segments are somewhat different in these cuticular structures. The ventral U-shaped chitinization is not present on the cephalic two sterna; the dorsal U-shaped chitinization is widely interrupted on the meson of the first tergum by the intruding postscutellum, being represented by a pair of separate lateral arms; the ventral chitinization of the third segment is also interrupted slightly by the special large, brown, oval, spinous patch; the setæ on the dorsocaudal region are usually wanting on the first and seventh segments, and the small, spinous, lateral patches are wanting on the first, second, and seventh abdominal segments.

The anal disc (Plate 1, fig. 5) is oval, more pointed on its caudal region in the female than in the male, thickly chitinized, composed of roughened chitin corrugated along the margin, and divisible into two parts by a deep furrow. These two parts are slightly movable along this furrow, and they are held at a different angle to the body axis, the upper part being almost perpendicular and the lower distinctly oblique (Plate 1, fig. 3). The upper part is lunate. The convex margin is heavily thickened, irregularly dentated into strong spines, and usually provided with two pairs of strong setæ. The surface of this region is distinctly roughened by numerous minute depressed dots and provided with two small setæ along its margin. The lower part is large and fringed with a row of slender setæ on its thickened margin. The dorsal surface of this part is very slightly elevated caudad on the meson, entirely covered with minute spines, and provided with small, strong, scattered spines, U-shaped brown markings on the meson, and two pairs of large and small setæ on the depressed areas. On the ventral side there are many large setæ, which are attached to the tubercles on the marginal area, and a pair of strong hooks on the caudal end, curved cephaloventrad.

The terminal segment just before the anal disc is very narrow, especially on the tergum, and provided with several slender setæ on the ventrocaudal margin, and in the male pupal exuvia there is a brown marking on the ventrocephalic area, as shown

in Plate 1, fig. 4. The sheaths of the genital structures are on the ventral side of the anal disc. In the female the genital sheaths are pointed (Plate 1, fig. 1) and in the male blunt (Plate 1, fig. 4). In the female the sheaths of the ovipositor are very small, provided with about four small setæ on the base, and the paired sheaths are contiguous, forming a double-headed papilliform projection at the caudal end. The sheaths of the cerci are also quite contiguous with each other, forming a large common lobe, which is devoid of setæ. In the male the sheaths of the claspers are comparatively large, forming a pentagonal common lobe, which is deeply depressed on the meson and devoid of setæ.

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ILLUSTRATIONS

[Drawings by M. Tokunaga.]

TELMATOGETON JAPONICUS TOKUNAGA

PLATE 1

FIG. 1. Female pupa, ventral aspect.
2. Female pupa, dorsal aspect.
3. Female pupa, lateral aspect.
4. Male pupa, genital sheath, ventral aspect.
5. Male pupa, anal disc, caudal aspect.

PLATE 2

FIG. 6. Full-grown larva, lateral aspect.
7. Larval head capsule, dorsal aspect.
8. Larval head capsule, ventral aspect.
9. Larval antenna, lateral aspect.
10. Larval labrum-epipharynx, cephalic aspect.
11. Various hooklets of larval epipharynx.
12. Premandible, mesal aspect.

PLATE 3

FIG. 13. Sinistral larval mandible, dorsal aspect.
14. Sinistral larval mandible, ventral aspect.
15. Larval hypopharynx, dorsal aspect; *f*, featherlike setæ of hypopharynx.
16. Sinistral larval maxilla, dorsal aspect.
17. Sinistral larval maxilla, ventral aspect; *a* to *c*, various cuticular structures.
18. Larval maxillary palpus.

TEXT FIGURE

FIG. 1. Distribution of various littoral animals associated with the green alga on the surface of a piece of stone that shows a high population of the insect *Telmatogeton japonicus* Tokunaga.

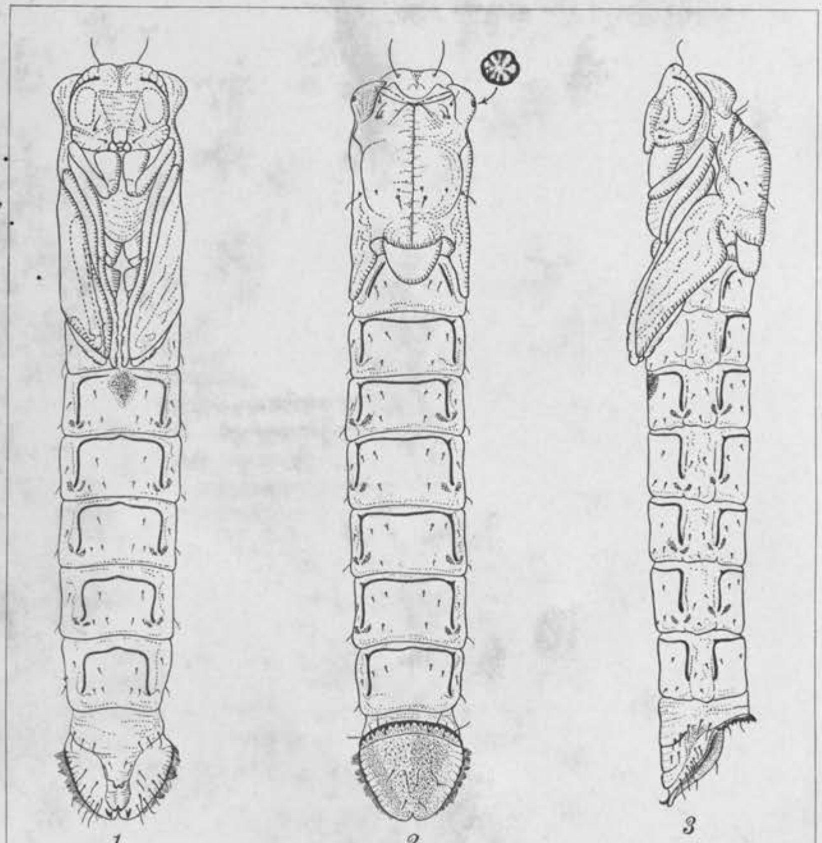

PLATE 1.

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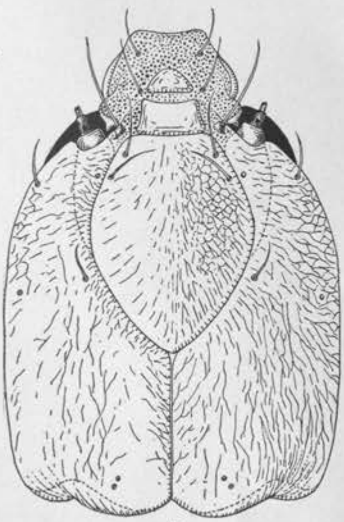

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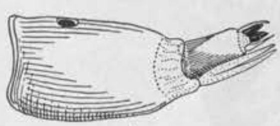

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PLATE 2.

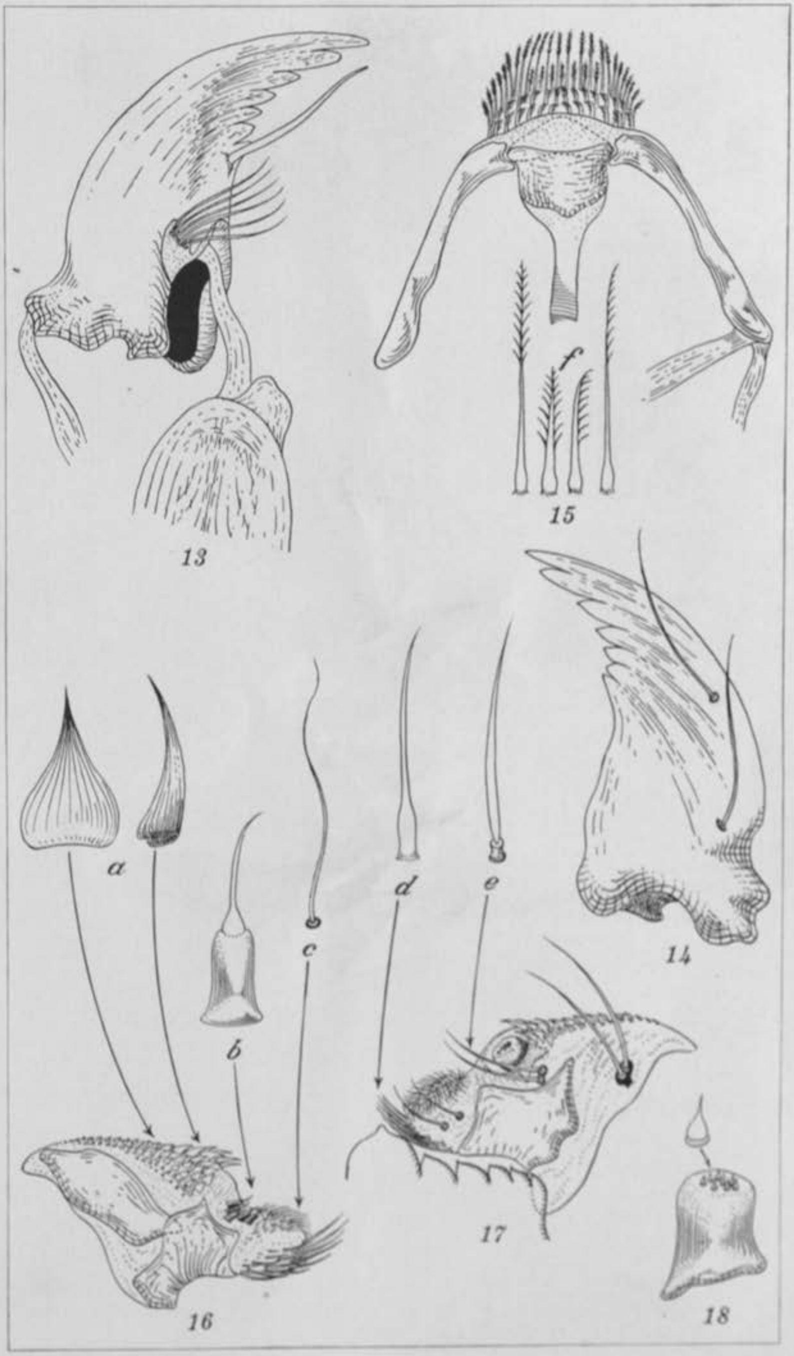

PLATE 3.

ERRATA

VOLUME 56

Page 224, in the eleventh line, *for* Parapercis montillai sp. nov. *read* Parapercis montillae sp. nov.

Page 225, in the thirteenth line, *for Montillai read Montillae.*

Page 227, under "Plate 3," *for Parapercis montillai* sp. nov. *read Parapercis montillae* sp. nov.

Sequence of plates: *For* Plate 2 *read* Plate 3, *for* Plate 3 *read* Plate 2.

VOLUME 57

Pages 326 and 327, all figures are expressed in percentages.

Volume 57

Page 326, column 1, under CaO, on wet basis, *for* 1.96 *read* 0.96.

INDEX

[New names and new combinations are printed in boldface.]